NOVEMBER 1958

CIVIL ENGINEERING

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

Proposed United Engineering Center On United Nations Plaza, New York

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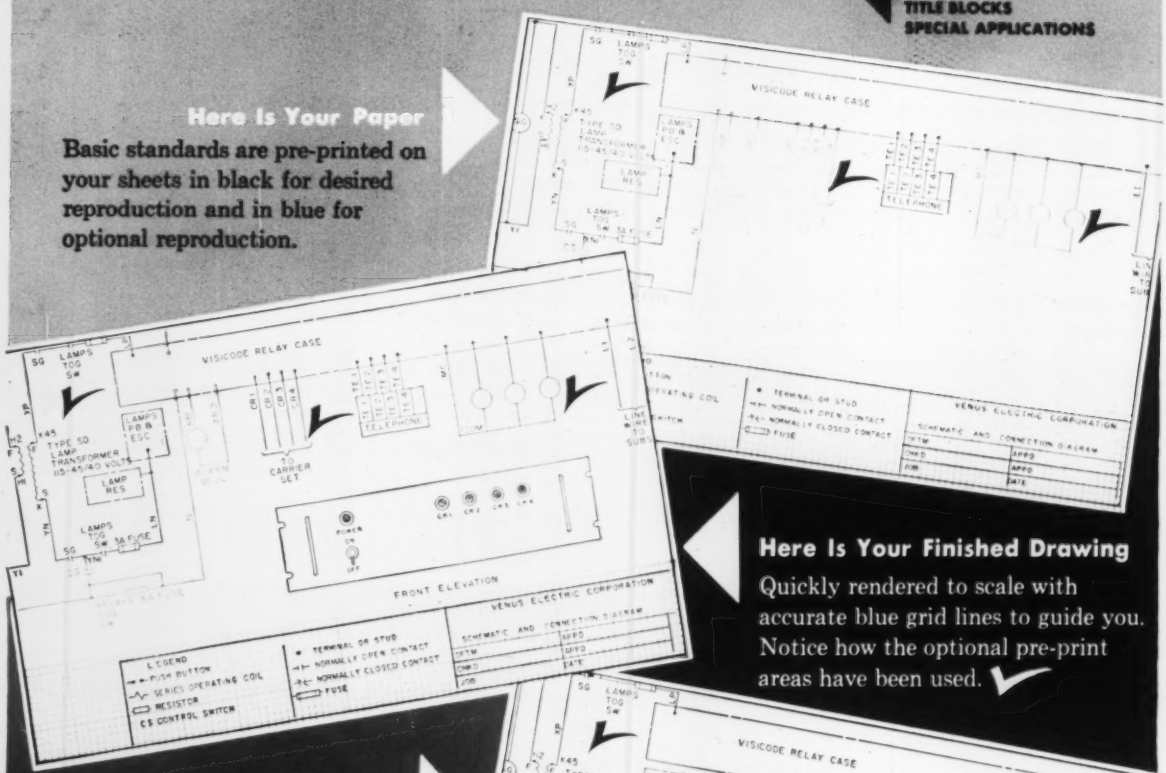

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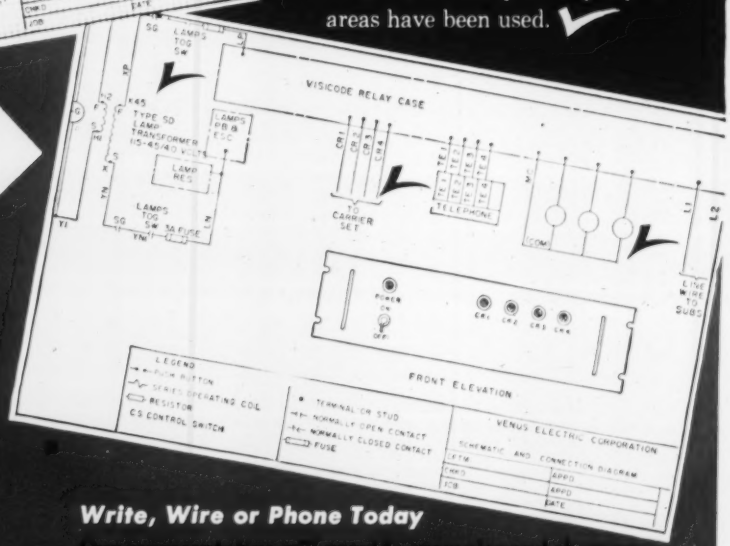

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Vitrified Clay Pipe is the only pipe backed by a long-term written guarantee—your assurance of corrosion-proof service long after the last bond has been retired.

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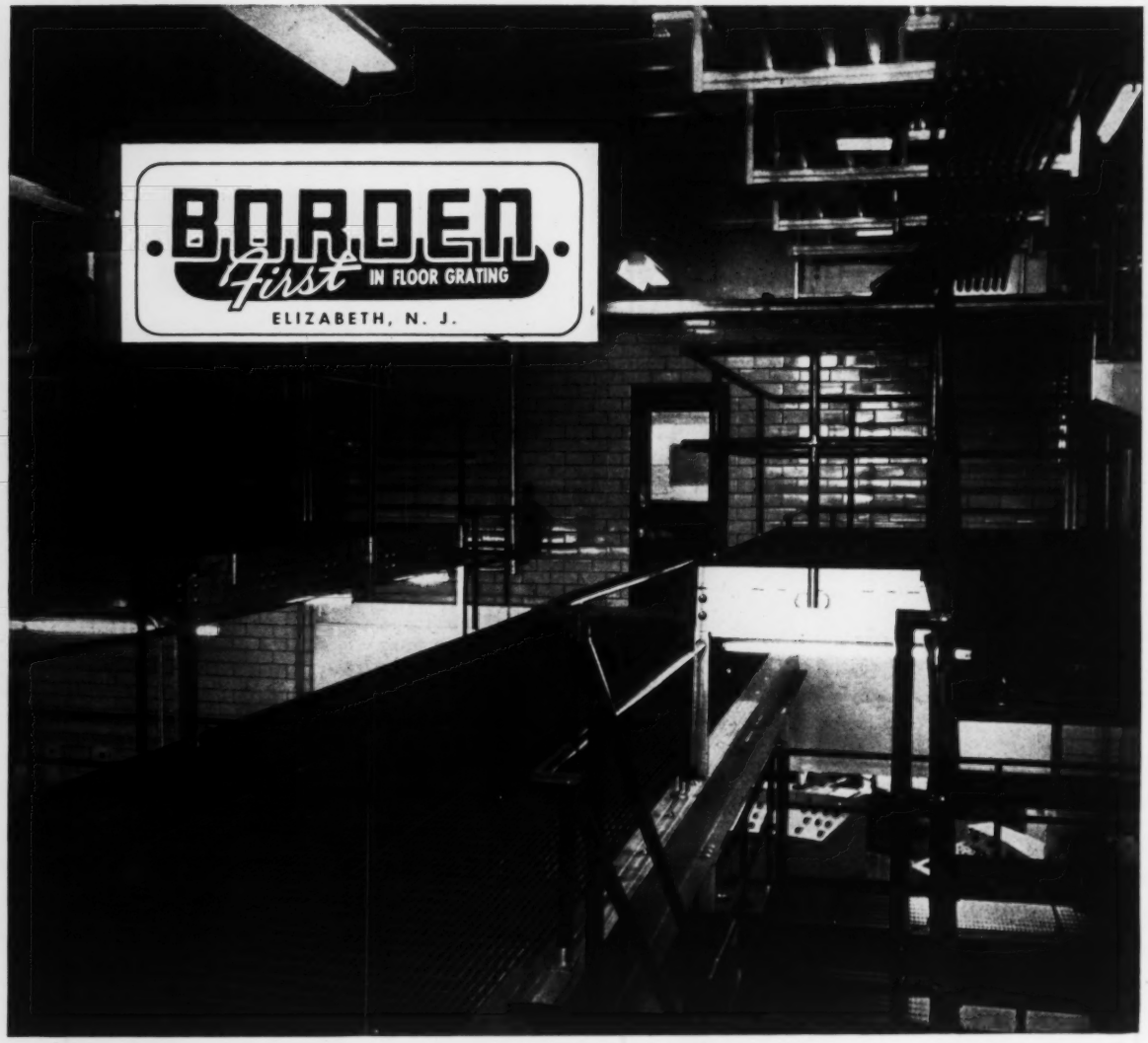

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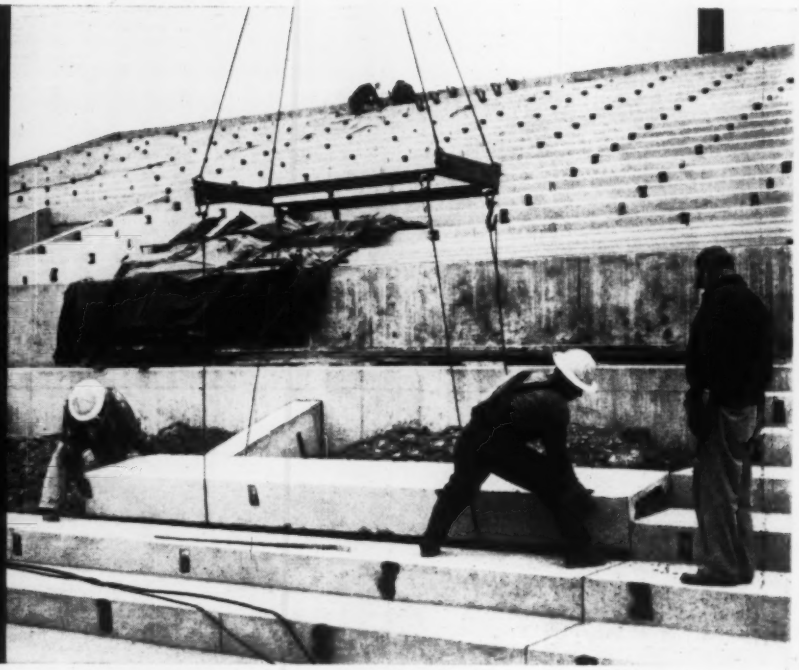
PRECAST SEAT BEAMS SPEED COMPLETION OF BALL PARK



Seat beams were anchored by welding plates on seat undersides to plates on grade beams. 1082 seat beams were required. Weighing approximately 1800 lbs. apiece, they ranged in width from 2'8" to 3' and in length from 13' to 14'.

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● Structural work on the new Fairground Park baseball stadium for the "Spokane Indians" did not get underway until February, 1958, yet the job had to be completed by the season's opener on April 29th. This need for fast work, without sacrifice of economy or quality, led to the choice of precast concrete seat beams for this job.

Using Lehigh Early Strength Cement, the manufacturer turned out 44 seat beam sections every day, from 550 lineal ft. of forms. Without the use of High Early Strength concrete, at least double the quantity of forms would have been needed to meet the tight schedule.

This is typical of the advantages of Lehigh Early Strength Cement in modern concrete construction.

With modern construction methods and Lehigh Early Strength Cement, the manufacturer was able to complete casting of the beams for this 8500-seat baseball stadium in less than 5 weeks.

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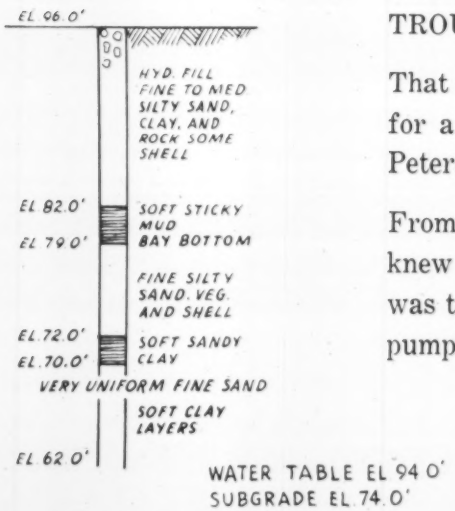
MORETRENCH WELLPOINTS CHANGE A PROBLEM INTO A PLEASURE...



Twenty feet of water in silty sand with clay layers spell TROUBLE!

That was Florida Power Corporation's problem in excavating for a Discharge Canal for the Paul L. Bartow Plant in St. Petersburg, Fla.

From past experience on an intake well in the same area they knew that the quickest, most economical way to handle water was to install a topnotch wellpoint system. Twenty days after pumping started, the job was excavated to subgrade—in the dry.

KNOW-HOW is a prime factor in the success of any wellpoint installation. That's only one of the many reasons for Moretrench's ability to produce results on difficult jobs. For practical help on your wet problem, call us.

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Bolts join structural members of new bank building in Detroit

Here's the newest of the impressive structures in Detroit's financial district—the 14-story main office building of National Bank of Detroit. Upon completion, the up-to-the-minute structure will contain about 420,000 sq ft of usable floor space. The steel members of its structural framework, weighing approximately 6,000 tons, are connected by more than 102,000 Bethlehem High-Strength Bolts, Nuts, and Washers.

Facade of main office building of National Bank of Detroit will have pleasing shadow effect, resulting from unusual combination of glass, stone, and metal. Architects and Engineers: Albert Kahn Associated Architects and Engineers Inc.; General Builders: Bryant & Detwiler Co.; Steel Fabrication and Erection: Bethlehem Steel Co.

BOLTING IS FAST. Bethlehem High-Strength Bolts are ideal for erecting structural steel because of the speed with which they can be installed. A pneumatic impact wrench is all that's required when tightening the nuts.

BOLTING IS QUIET . . . AND SAFE. High-strength bolting is relatively quiet, making it a highly desirable construction technique in business, hospital, and school areas. Here's another advantage: with the bolts installed cold, there's no possibility of fire, or injury from tossed metal.

Bethlehem High-Strength Bolts, Nuts, and Washers come in a full size range, quenched and tempered to meet the requirements of ASTM Specification A-325. Our nearest sales office will give you full details.

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. . . The chart at right tells the story . . . Under difficult on-the-job conditions this Curtiss-Wright CW-226 *averaged* more than 5 yds. better than rated capacity . . . moved this load at money-making speed — dumped swiftly and evenly . . . This type of job-proven performance keeps cost-per-yard figures *down* — profit figures up! . . . Every piece of Curtiss-Wright construction machinery is built to *earn* its price many times over — see your distributor today for complete information on the CW-226 and the many other units in the Curtiss-Wright line!

THIS ON-THE-JOB PERFORMANCE REPORT TELLS THE STORY

MODEL CW-226

2-axle, self-propelled scraper designed for rated capacities of:

26.0 Cu. Yds. Struck
36.0 Cu. Yds. Heaped

Average Payload Hauled:	31.2 Cu. Yds.
Loaded Unit Speeds to:	38. m.p.h.
Average Loading Time: (with single pusher, less than top h.p. rating)	1 min., 30 sec.
(with tandem pusher)	50 sec.
Average Loads:	85,800 lbs.

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2. **HIGH FLOW CAPACITY...**
   Cement lined cast iron pipe and fittings will not tuberculate . . . delivers a full flow for the life of the pipe.
3. **LONG LIFE...**
   42 North American cities are still using cast iron water mains laid 100 years and more ago. Hundreds more have passed the 50 year mark.
4. **BEAM STRENGTH...**
   Cast Iron Pipe is inherently tough . . . stands up under heavy traffic load, soil displacement and disturbance.
5. **CORROSION RESISTANCE...**
   Cast Iron Pipe effectively resists corrosion . . . vital factor in its long life and dependability.
6. **TIGHT JOINTS...**
   A full range of leak-proof, low cost, easy-to-assemble joints for pipe and fittings are available for all conditions.

Before you choose any pipe remember this important fact . . . it will save you many a headache later.

In all the history of water systems no substitute pipe has ever come close to matching cast iron pipe's century old record of dependability, long life and long term economy.

Specify cast iron pipe, and your pipe worries are over, not just beginning. Cast iron's performance is based on PROOF not claims!

THE MAN WHO CHOOSES CAST IRON PIPE TODAY WON'T PAY FOR IT AGAIN TOMORROW!

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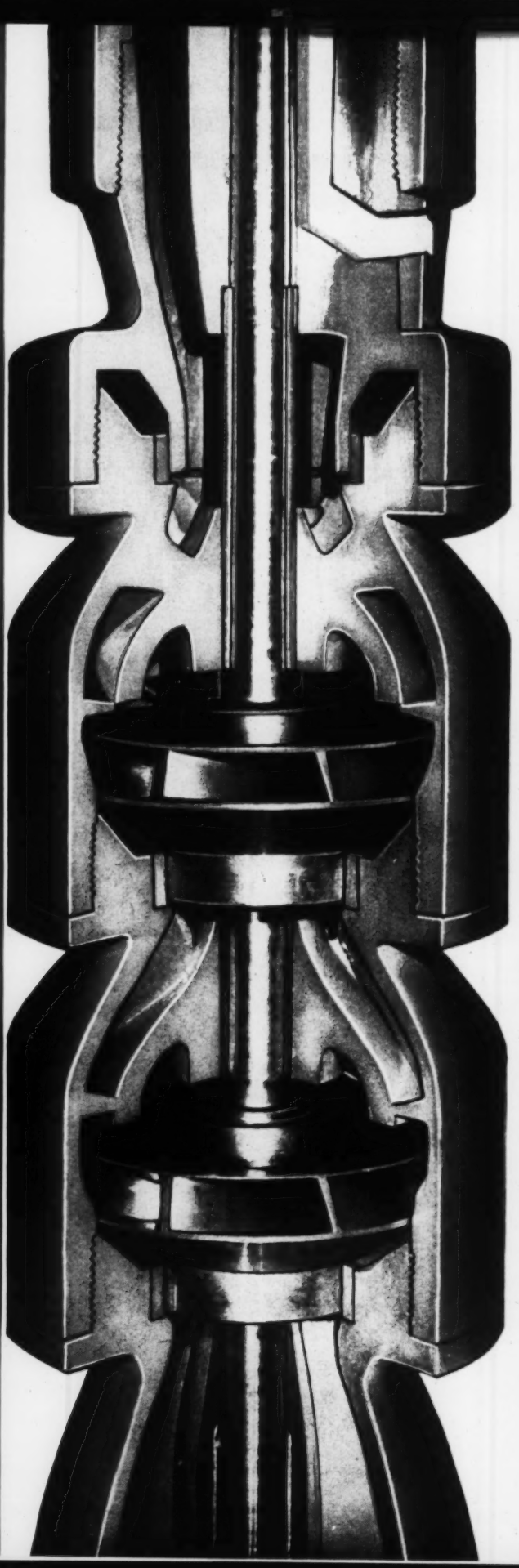

If your problems are concerned with a new plant or the expansion of present facilities, Layne Vertical Turbine Pumps fill any need.

Whether the supply or the demand calls for a 4 inch well or any size up to 42 inches, Layne Pumps are designed and engineered to deliver the required GPM economically and unfailingly.

Pioneers and acknowledged leaders in the field of water, Layne produces pumps designed to meet multiple service requirements efficiently and economically.

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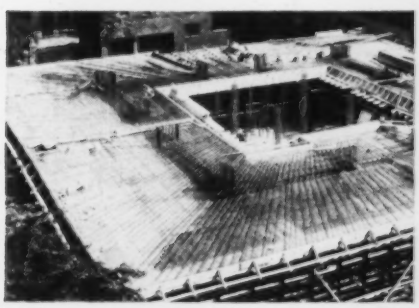
It's one of Chicago's finest luxury apartment buildings, 21 stories overlooking Lake Michigan at 320 Oakdale. Beneath its attractive exterior, 12,000 cu. yds. of concrete form a frame and floor skeleton of outstanding strength.

Architect Milton M. Schwartz of Chicago and structural engineers from Miller Engineering Co. chose reinforced concrete for its rigidity and durability—and passed along big bonuses in economy to their client, too.

Concrete saved an estimated $200,000 through reduced materials cost, easier construction scheduling. It made a simple job of the cantilevered overhangs. And because floors are flat slabs, it saved a full story in total height.

Concrete needs no special fireproofing. It can't rust or rot. No other material offers such low maintenance cost. More and more architects and engineers are specifying concrete frame and floor construction today. They're finding the same kind of economies for all structures, of both conventional and modern design.



Reinforcement being placed for large, cantilevered 2nd-floor slab, a construction so easily achieved in reinforced concrete.

FOR STRUCTURES... MODERN

concrete

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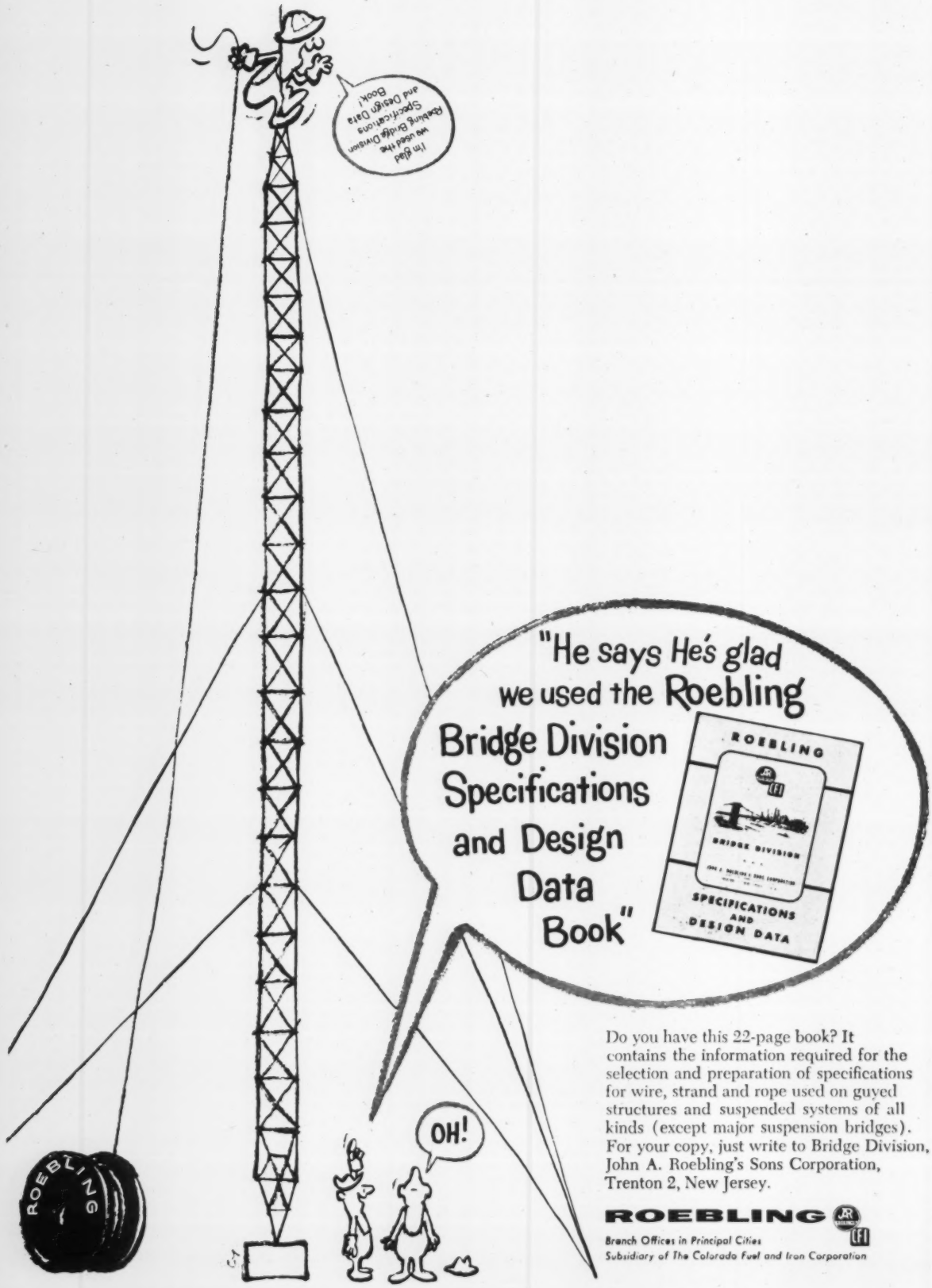
A national organization to improve and extend the uses of concrete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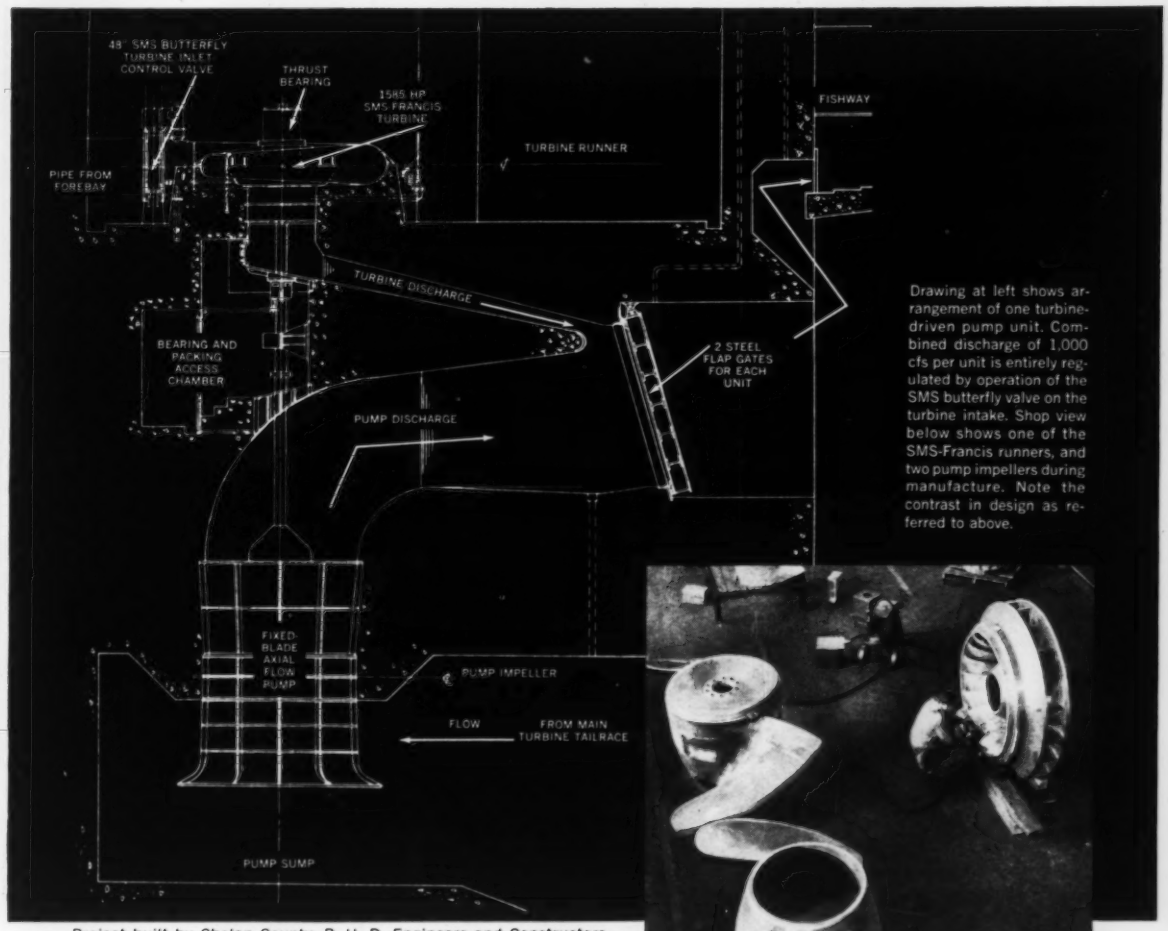

Drawing at left shows arrangement of one turbine-driven pump unit. Combined discharge of 1,000 cfs per unit is entirely regulated by operation of the SMS butterfly valve on the turbine intake. Shop view below shows one of the SMS-Francis runners, and two pump impellers during manufacture. Note the contrast in design as referred to above.

Project built by Chelan County, P. U. D. Engineers and Constructors: Stone & Webster Engineering Corp., Wenatchee, Washington

SMS Turbine-Driven Pumps Used in Rocky Reach Fishway

In addition to the seven 140,000 HP SMS-Kaplan turbines that will harness the Columbia River at Rocky Reach Hydroelectric Project, three special SMS turbine-driven pump units will provide water for the fishway system. These are SMS-Francis turbines, with a 48-inch SMS butterfly valve on the spiral case inlet. A fixed-blade, axial flow pump is directly coupled to the turbine. Two semi-buoyant structural steel flap gates prevent reverse flow from the fishway.

An interesting contrast is present in this arrangement, in that a very low specific speed turbine runner (normally used for 800 to 1000 foot heads) operating under 60 to 90 foot head is used to match the speed and drive a very high specific speed pump impeller, designed for pumping a 4 to 5 foot, pool to pool head. This simplified arrangement eliminates the multiplicity of conversion losses inherent with a motor drive and results in increased overall efficiency and simplification of controls.

Current bulletins describing SMS hydraulic turbines, pumps and accessory equipment, as used in the above installation, are:

#152 – Francis Turbines • **#163** – SMS Water Control Gates • **#164** – Complete Valve and Remote Control System • **#165** – Adjustable and Fixed Blade High Capacity Axial Flow Pumps

Write S. Morgan Smith Company, York, Pennsylvania for further information.

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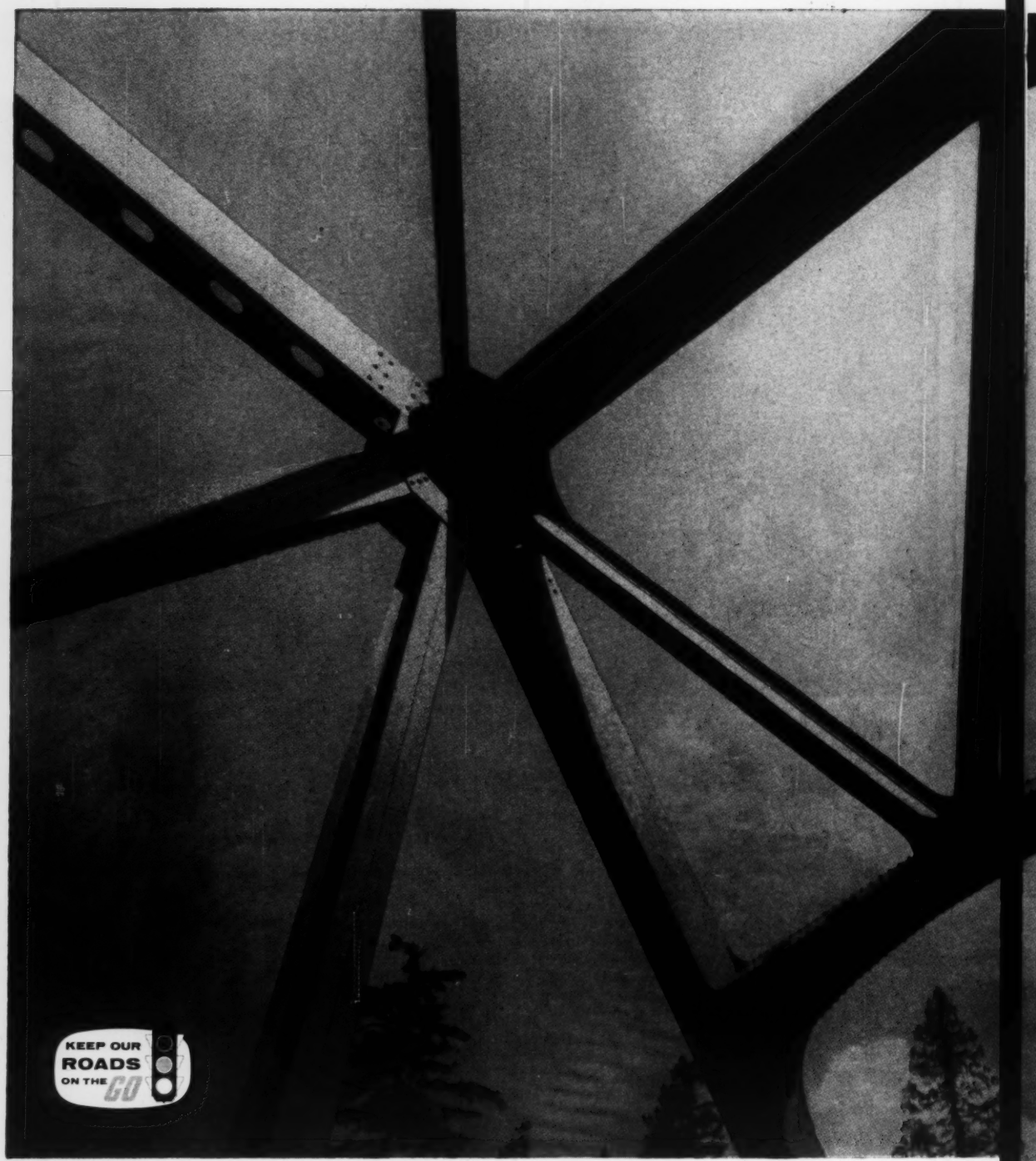
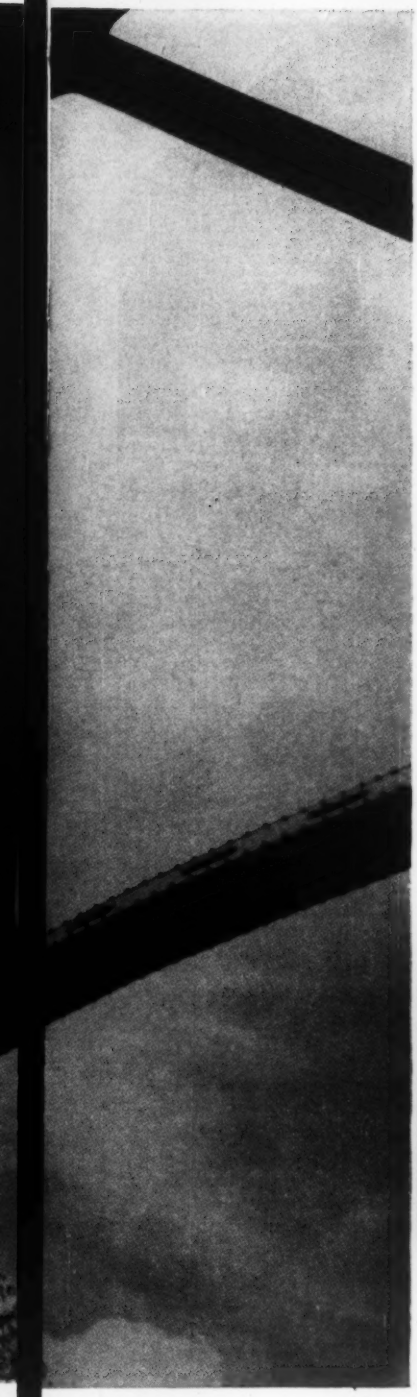
Bridge designers save



The 1,020′ Agate Pass Bridge is of through cantilever truss construction, built with 1,561 tons of steel. 650 tons are USS COR-TEN Steel, a high-strength low-alloy steel that eliminated 300 tons of dead weight and saved $87,000 in total steel costs.

$87,000 with USS COR-TEN Steel



in the Agate Pass Bridge

WHEN YOU BUILD with a stronger steel, you need less steel. That's why this bridge was built with USS COR-TEN Steel chords, floor beams, diagonals and verticals. Because COR-TEN Steel is 50% stronger than structural carbon steel, the members are thinner. According to estimates by the State of Washington, Dept. of Highways, COR-TEN enabled a total weight elimination of 300 tons of steel—an $87,000 saving.

USS COR-TEN Steel has a minimum yield point 50% higher than that of structural carbon steel, and in thicknesses of ½" and under it meets all the requirements of ASTM Specification A242 for High-Strength Low-Alloy Steels. On this bridge, the COR-TEN Steel members are about one-third lighter than carbon steel would be if used in the same locations. Dead weight was materially reduced, freight costs were lower, and construction was easier. And, since COR-TEN Steel has 4 to 6 times more resistance to atmospheric corrosion than carbon steel, the Agate Pass Bridge will stand up better under the corrosive salt air of this area.

For more information about weight-saving, economical construction with USS High Strength Steels—COR-TEN, TRI-TEN, and MAN-TEN—write for a copy of our "Design Manual for High Strength Steels," United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

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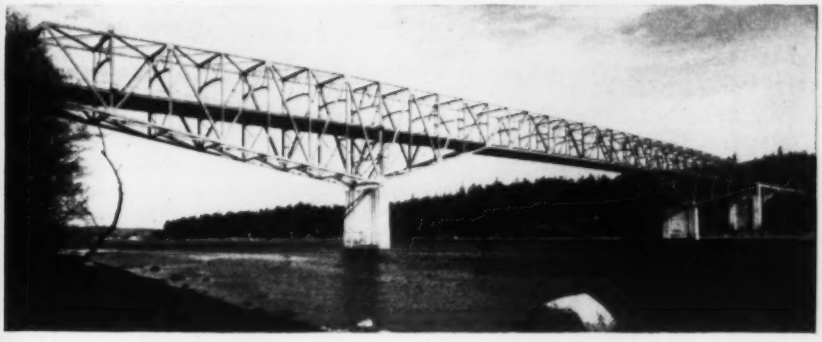

The Agate Pass Bridge • Owner: State of Washington • Designer: Department of Highways, State of Washington • Contractor: Manson Construction & Engineering Co. • Fabrication and Erection: American Bridge Division, United States Steel

United States Steel Corporation – Pittsburgh
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LIGHTING YOUR WAY TO A SAFER FUTURE

Safeguarding lives is the aim of Oldsmobile's new electronic headlamp aiming device that makes sure every Oldsmobile has perfect "see-ability".

Night driving safety depends upon how precisely headlamps are aimed. Minute errors in adjustment can mean the difference of several square feet in light area on the road. To be completely on the "safe side", Oldsmobile aiming standards specify that lights be aimed *twice* as accurately as required by state laws.

To make certain that every light is aimed perfectly, Oldsmobile engineers developed an ingenious electronic device that effectively measures light intensity and direction, even at Oldsmobile's highest production rate.

On the assembly line, every car is automatically shuttled to the aiming platform where two probes rise out of the floor and "feel" the exact location of the car. The "eyes" of the aiming device then align themselves with the centerline of the car. A series of photoelectric cells instantly record the light intensity and direction on large dials. A built-in scanning circuit then inspects all settings of the headlamps to make certain they are accurate. If there is an error, a colored soap solution is automatically sprayed on the windshield, and the headlamps are re-aimed.

Oldsmobile takes pride in producing an automobile as advanced in every respect as modern technology can make it. However, you owe it to yourself to have your headlamps periodically checked. As part of General Motors' public-spirited "Aim to Live" program, your Oldsmobile Dealer is featuring headlamp aiming, as well as other important safety services for you. Stop in soon . . . and while you are there, take a test drive in a new Olds—sales leader of the medium price class.

OLDSMOBILE DIVISION, GENERAL MOTORS CORP.

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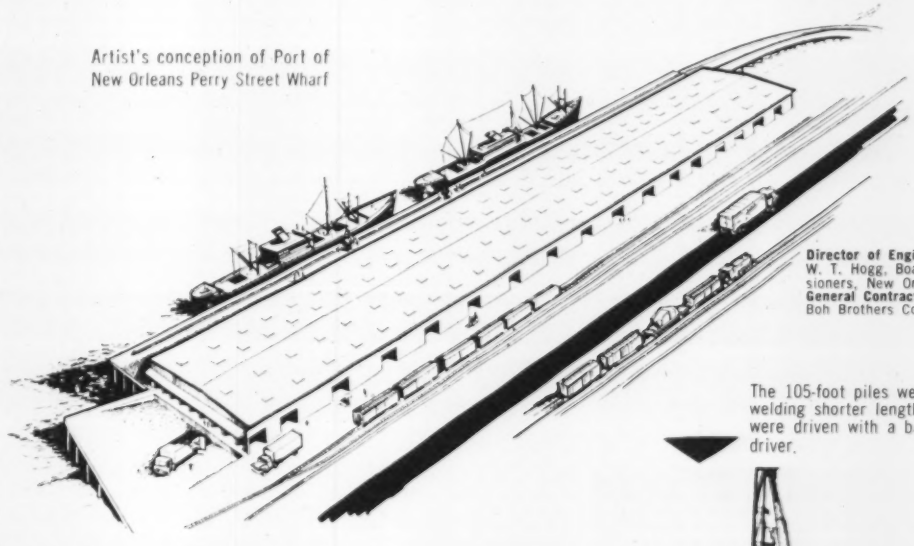
Pioneer in Progressive Engineering ... Famous for Quality Manufacturing

More than 50 miles of Armco Piling provide solid foundation for New Orleans wharf



Artist's conception of Port of New Orleans Perry Street Wharf

Director of Engineering
W. T. Hogg, Board of Port Commissioners, New Orleans, Louisiana
General Contractor
Boh Brothers Construction Company

The 105-foot piles were made by field-welding shorter lengths together. Piles were driven with a barge-mounted pile driver.

The 1000- by 230-foot Perry Street Wharf is part of the Port of New Orleans' 72 million dollar dock improvement program. When completed, this wharf will include berths for loading and unloading two ships, dockside rail lines, truck docks, and a 160,000-square-foot warehouse.

Armco Pipe Piles were selected to provide a solid foundation for the wharf. A total of 2800 piles in 18-, 16-, 14-, and 12¾-inch diameters were driven and filled with concrete. The Armco Piles, field-welded in 105-foot lengths, were tied into the wharf deck with 1-inch reinforcing bars. Design load for each pile is 50 tons.

Many engineers and contractors have found Armco Pipe Piles the most efficient and economical answer for foundations under bridges, buildings, and similar structures. For more details, just send the coupon below. Armco Drainage & Metal Products, Inc., 4618 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.

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Organization_____

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City_____ Zone____ State_____

From one to a fleet

with Allis-Chalmers Construction Machinery

Starting with a single tractor-dozer in 1949, R. Sam Krage Company of Sioux City, Iowa, now owns a fleet of Allis-Chalmers construction machines. Sam Krage attributes much of his success as a dirt mover to the operation and performance of his equipment, and to the top-notch service his Allis-Chalmers dealer provides.

Sam Krage, Sioux City, Iowa

Big TS-360 motor scrapers are heaped to 20-yd capacity with help of the 225-hp HD-21 crawler tractor. Krage especially likes the ease with which these machines handle wet dirt.

Look ahead... *move ahead*...and stay ahead

Top production, day after day makes Allis-Chalmers tractor-dozers, like this HD-11 shown spreading fill, Krage's choice.

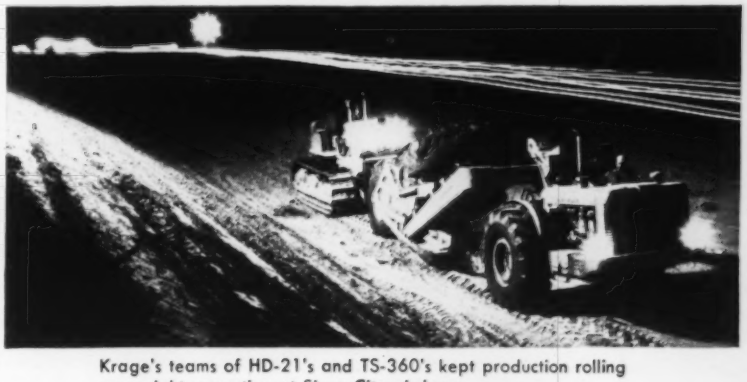
Top production record on a wide variety of jobs

From small farm pond and dam construction with his first tractor, Krage branched off into clearing work for highway contractors. Since then he has moved into highway grading himself, both in Iowa and South Dakota. He also has done levee work on the Missouri River, and most recently handled a big air base job at Sioux City.

In this wide range of construction jobs, Sam Krage says he has benefited from an outstanding "time-on-the-job" record from his Allis-Chalmers equipment. Best proof of his confidence is the well-balanced fleet of Allis-Chalmers machines he now owns . . . big motor scrapers, crawler tractors, pull scrapers, and heavy-duty motor grader.

A number of the motor scrapers are TS-260's—rated 11 yd struck, 14 yd heaped. On a recent 800,000-yd highway job in Iowa, Krage says these machines loaded, hauled and dumped at the rate of 55 trips an hour on a 1,400-ft haul. On the Sioux City air base job, his TS-360's (15 yd struck, 20 yd heaped) handled 450 loads a day on average hauls of 1,600 ft.

On air base job, the Forty Five motor grader kept haul roads smooth, allowing the TS-360's to travel safely at high speeds.



Krage's teams of HD-21's and TS-360's kept production rolling on a night operation at Sioux City air base.

Easy handling makes a big hit with operators

Krage says his operators like the way their Allis-Chalmers equipment handles, and that means extra production.

On the air base job, they were able to utilize the top horsepower-per-yard ratios in the TS-360's and TS-260's. Results—even in wet material, they loaded and hauled easily . . . and with positive, forced ejection, plus high apron opening, unloaded fast and clean.

Features designed for the operator's benefit on Allis-Chalmers tractors and motor graders are also considered important by Krage and his men. Torque converter drive on the HD-21 and HD-16 crawler tractors . . . and new toggle-type controls on the Forty Five motor grader are two examples. Both have the same effect—easier operation, more production.

Proved quality in parts and dealer service important factor

Sam Krage made his first extensive purchase of Allis-Chalmers equipment in 1952, was so well satisfied with its operation and performance that he has continued to purchase it.

Krage says that parts availability and prompt dealer service figure high with him in purchasing the type of equipment he needs in his work. In both respects he's had extremely good relations with his Allis-Chalmers dealer.

Your local Allis-Chalmers construction machinery dealer is ready to help you with equipment and application recommendations, around-the-clock parts and service. Call him now for a working demonstration of the performance that sold Sam Krage. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

with ALLIS-CHALMERS

Weldforged GRATING

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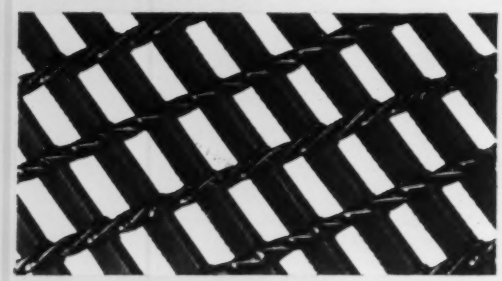
. . . and in the future Weldforged GRATING on other Planets!

150 years ago it was demonstrated that steamships could never cross the Atlantic and as late as 1903 it was proved that man could not fly, so, we believe, it is not unreasonable to say that our grating will be in use on other planets in the not-too-distant future.

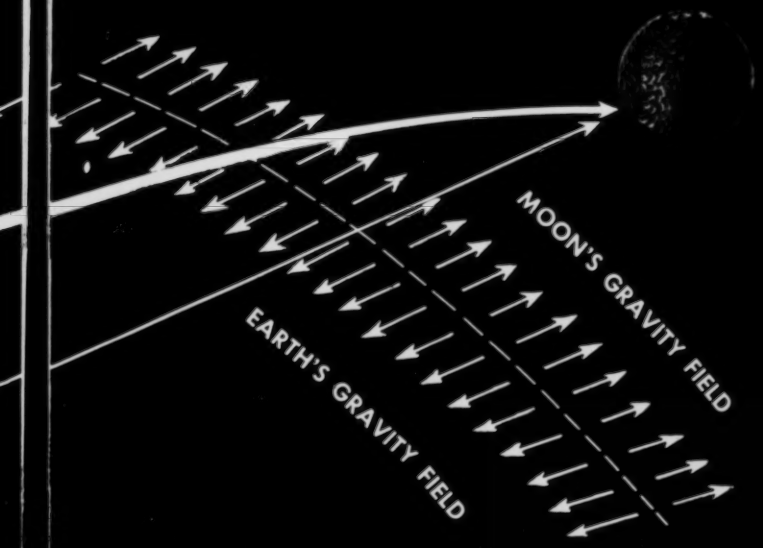
Already, in a short span of 12 years, we have become one of the leading grating manufacturers in the world today. Our installations are located all over the United States and in many foreign lands. One of our latest is on the largest steel island . . . for Freeport Sulphur Company. (See photograph at right). Here, approximately 300 tons of our galvanized welded steel grating have been installed.

Having pioneered many new designs and improvements in the grating field, today we are in position to furnish grating for every possible need . . . in steel, stainless, or aluminum; and in welded, riveted, pressure-locked, or our new Roll-Lock, designs. We invite your inquiry for our new catalogs. Address: Dep't C-11.

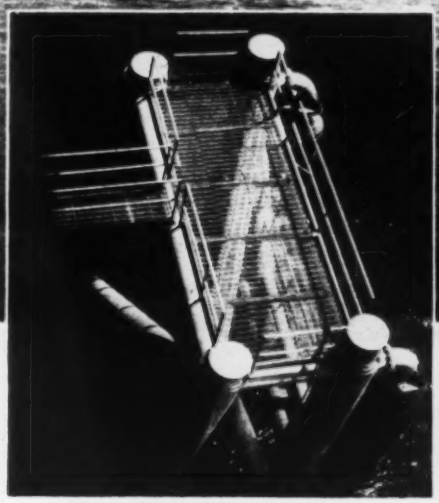


Spiral bars are Weldforged into bearing bars to form solid, one-piece units. Spirals alternate right and left and are slightly raised above bearing bars for greater safety underfoot.

WELDFORGED GRATING & TREADS—GREULICH 4-WAY OPEN STEEL BRIDGE FLOORING—STREET LIGHT STANDARDS



...ON THE WORLD'S LARGEST S-T-E-E-L ISLAND!



World's largest steel island 7 miles off the coast of Louisiana. This first off-shore sulphur mining plant is Y-shaped, stretching for ½ mile and reaching 60 ft. above the water. Structure is principal part of a $30 million project undertaken by Freeport Sulphur Company to develop a major new sulphur deposit known as Grand Isle.

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NEWS OF ENGINEERS

Fred W. Clayton has joined the United States Mutual Security Program which is administered by the International Cooperation Administration. With the Security Program, Mr. Clayton will serve as transportation and industry officer for I.C.A.'s mission in Afghanistan. He has been assistant chief of the Common Carrier Bureau of the Federal Communications Commission in Washington, D. C.

Ralph W. Powell has retired from engineering teaching after a career of 47 years. Professor Powell taught in the Department of Mechanics and Hydraulics at the State University of Iowa and also spent a year at the University of Kansas. He has served as secretary of the Rocky Mountain Hydraulic Laboratory in Allenspark, Colo. Professor Powell is now living at 4025 Oakfield Drive, Sherman Oaks, Calif.

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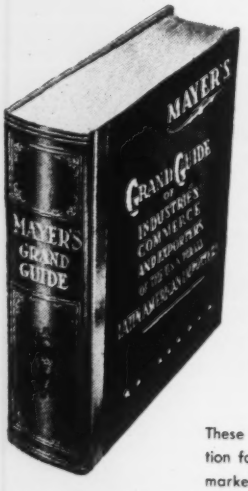

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WE HAVE A FEW LOCATIONS OPEN FOR REPRESENTATIVES

Peter J. Reidy has resigned as president of the New York City consulting firm of Purdy & Henderson to accept Mayor Wagner's appointment to the important post of commissioner of the New York City Buildings Department. The department Mr. Reidy will head has been traditionally faced with investigations of bribery in its relations with contractors and landlords. As head of Purdy & Henderson Mr. Reidy has been responsible for the design of a number of major New York City buildings, including the Bank of Manhattan at 40 Wall Street and the Metropolitan Life Insurance buildings.

P. J. Reidy

Frederick C. Tonetti has been appointed assistant director of research with Ebasco Services Incorporated, New York City. Mr. Tonetti has been with Ebasco for 23 years, serving most recently in the research department.

David R. Storm has accepted a position with the Tudor Engineering Company, consulting engineers of San Francisco, Calif. Mr. Storm was formerly on the faculty of the U.S. Naval Academy in the Department of Marine Engineering.

Robert S. Loomis announces the formation of a partnership with **Raymond H. Loomis** for the practice of professional engineering. The firm, Loomis and Loomis, will specialize in structural engineering and soil mechanics and will have offices in the Savings and Loan Building, 252 Broad Street, Windsor, Conn.

Clyde Guder has been appointed district engineer for the St. Louis area of the American Institute of Steel Construction. Prior to his appointment, Mr. Guder was active in designing and supervising construction of steel structures. He has been head of the Guder Building Company in Topeka, Kans.

Cyril D. Jensen has been granted a leave of absence from Lehigh University to accept the post of director of research and testing for the Pennsylvania Department of Highways. Professor Jensen has been on the Lehigh faculty since 1925—of recent years as professor of civil engineering and chairman of the soil mechanics division of the Fritz Engineering Laboratory. On leave of absence during the war, he was engaged in welding research for the U.S. Naval Experiment Station at Annapolis, Md.

(Continued on page 23)

NEWS OF ENGINEERS

(Continued from page 22)

Henry M. Wasung announces the removal of his consulting engineering office to 63 May Drive, Chatham Township, N. J. Before opening his office, Mr. Wasung was chief estimator with the Drilled-In Caisson Corporation in New York City.

Theodore von Karman, Honorary Member of ASCE, has been awarded the Timoshenko Medal of the ASME for outstanding work in the technical field of applied mechanics by the American Society of Mechanical Engineers. Dr. von Karman was named for "his contributions to the mechanics of fluids and solids, particularly those leading to major advancements in aeronautics." He is chairman of the Advisory Group for Aeronautical Research and Development of the North Atlantic Treaty Organization, Washington, D. C. His home is in Pasadena, Calif.

John B. Rutherford has opened an office for the practice of structural engineering at 141 First St., Los Altos, Calif. He recently resigned from the Western-Knapp Engineering Company in San Francisco, where he has been head of the structural and civil engineering department. Prior to joining Western-Knapp, Mr. Rutherford was associated with Russell Fuller, of San Francisco.

J. B. Rutherford

A. W. Freed has taken the post of technical associate for the Installations Division at McClellan Air Force Base in Sacramento, Calif. Mr. Freed comes to his new position from the Navy which he served in Newfoundland. Until 1957 he was chief engineer for the Public Works Department at the Naval Station in Seattle, Wash.

James E. Kunkler will become manager of the Central Division of the Armco Drainage & Metal Products, Inc., Middletown, Ohio. In his new post Mr. Kunkler will be in charge of the company's activities in Ohio, Kentucky and West Virginia. Until his promotion he was Southwestern Division sales manager, with headquarters at Houston, Tex.

Vaud E. Larson has taken the post of assistant project construction engineer for the Bureau of Reclamation on the Glen Canyon Dam unit of the Colorado River Storage Project. Mr. Larson, who is assistant director of the Bureau's Region 3, led the first investigations in Glen Canyon and later selected the site where the dam is being built.

(Continued on page 24)

For unobstructed flow...

Rodney Hunt HY-Q Flush Bottom Closure Sluice Gates completely eliminate the problem of debris and silt which accumulate at the sill of conventional gates. Unlike any other design, the HY-Q gate seats on a sill flush with the invert. It has neither a vertical sill wall nor a trough to trap debris and silt, obstruct free flow and prevent proper seating of the gate. Every opening of the gate flushes and clears the seating surface, assuring full, free, unobstructed flow.

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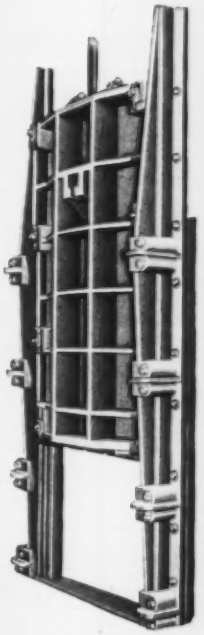

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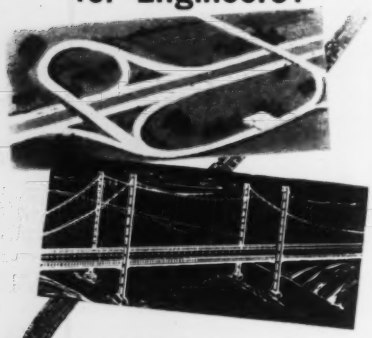

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NEWS OF ENGINEERS

(Continued from page 23)

Charles W. Lovell has become a partner in the firm of Jonson, Depp and Quisenberry, consulting engineers of Owensboro, Ky. He will have his headquarters in Louisville. Previously Mr. Lovell was with J. Stephens Watkins as project engineer.

Ernest L. Robinson, of Schenectady, N. Y., has been named an honorary member of the American Society of Mechanical Engineers. Mr. Robinson, retired structural engineer for the General Electric Company, was cited for "creative engineering . . . imagination in conceiving research and investigative programs of the highest order." A pioneer in steam properties investigations, Mr. Robinson developed the technique for eliminating destructive vibrations from steam turbine buckets which was used on the first American-built jet airplanes.

Ellis L. Armstrong has been appointed commissioner of the U. S. Bureau of Public Roads in Washington, D. C. For the past sixteen months Mr. Armstrong (left) has been director of the Utah

State Road Commission. Succeeding Mr. Armstrong at Salt Lake City is **Elmo R. Morgan** (right) who has been business vice president of the University of Utah.

Nathan C. Burbank, Jr., has been named professor of civil engineering and head of the department at Washington University in St. Louis, Mo. Until recently Professor Burbank was assistant director of research for Ifilco Inc., of Tucson, Ariz.

Wayne Teng, former assistant chief structural engineer for Skidmore, Owings & Merrill, has become connected with John F. Meissner Engineers, Inc., Chicago, as head of the structural department. Through an error that is much regretted Mr. Teng was incorrectly listed as chief structural engineer for Skidmore, Owings & Merrill in a "News of Engineers" item in the September issue.

(Continued on page 26)

Eduardo Torroja

PHILOSOPHY OF STRUCTURES

English Version by
J. J. POLIVKA and MILES POLIVKA

This volume discusses the basic concepts and ideals of advanced structural design. Although its primary purpose is to elucidate principles that are basic to any kind of building, its analyses of thin-shell roofs, gravity and arch dams, bridges, "hung" roofs, and other structures make it an important document in the history of modern architectural design. The book also discusses the nature of stresses in different types of structures, the proper use of materials, structural elements, design of retaining structures, construction methods, genesis of structural scheme, and the function of the designer in the construction enterprise as a whole. *416 pages, 205 illustrations,* $12.50

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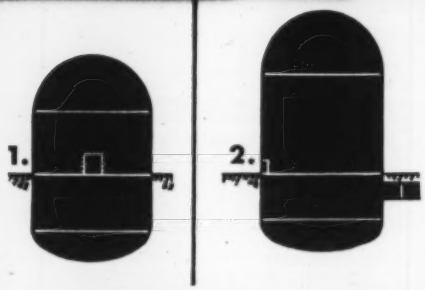
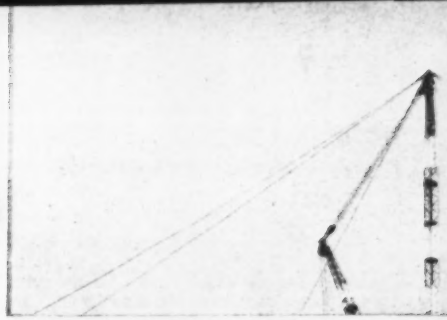
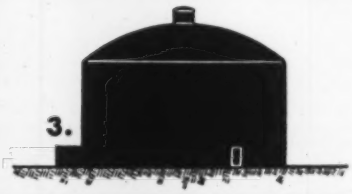
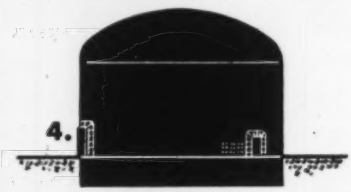


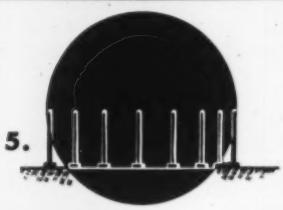


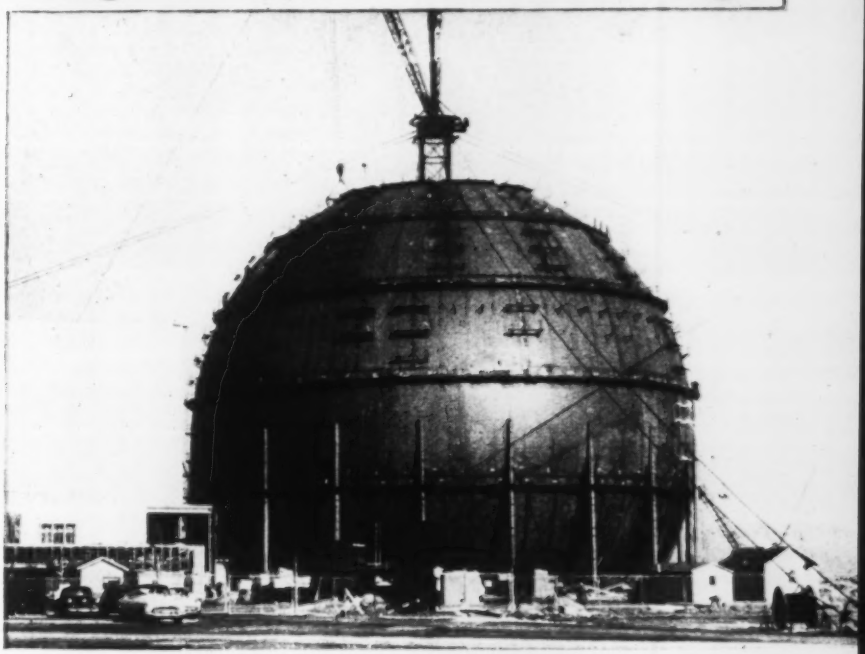
LAST PLATES GO IN AT DRESDEN STATION. 100-ton derrick with 170-foot mast lowers plates into place from 210-foot towers as 190-foot diameter Hortonsphere® nears completion at Dresden, Illinois Nuclear Power Station. CB&I-built structure will house atomic reactor. Station is a General Electric Co. project.

SHAPES OF things to come in the atomic age









CB&I Structures to Silhouette Major Reactor Projects

For CB&I engineers, fabricators and erection specialists, the challenge of things to come in the atomic age is, to a large extent, a reflection of existing accomplishments.

In 1954 the world's largest sphere, a Hortonsphere® measuring 225 feet in diameter, was built by CB&I for the AEC Knoll Atomic Power Laboratory at West Milton, New York, for testing a prototype of the atomic power plant which now serves our atom sub fleet.

Today, near Chicago, a skilled CB&I crew is completing the erection of a 190-foot diameter Hortonsphere to house an atomic reactor for the Dresden Nuclear Power Station. Near Detroit, another CB&I crew erected a reactor containment vessel of a different design for the Enrico Fermi Atomic Power Plant. Silhouettes of similar structures, being designed, fabricated or erected by CB&I, are shown here.

Yes, for CB&I, the shape of things to come in an atomic tomorrow had their beginnings *yesterday*. Experience gained in almost 70 years of furnishing *craftsmanship in steel* to serve Industry, Government and scientific research is now meeting the exacting requirements for reactor containment vessels.

E53CBR

1. Enrico Fermi Atomic Power Plant, Lagoona Beach, Michigan. (Power Reactor Development Co., Architect-Engineers)
2. U. S. Air Force, Dayton, Ohio
3. Atomic Energy Commission, Livermore, California. (Foster Wheeler Corp., Engineers)
4. Massachusetts Institute of Technology, Cambridge, Massachusetts. (John W. Cowper, Purchaser)
5. Dresden Nuclear Power Station, Dresden, Illinois. (Bechtel Corp., Constructor-Contractor)

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NEWS OF ENGINEERS

(Continued from page 24)

Joseph A. Bacci, of the U.S. Army Engineer District at Anchorage, Alaska, is a recent recipient of the Legion of Merit Medal awarded by President Eisenhower for "exceptionally meritorious conduct in nuclear and atomic energy fields." In addition he has been promoted to the rank of lieutenant colonel.

H. A. Schirmer has been appointed manager of fabricated steel contruction sales for the Bethlehem Pacific Coast Steel Corporation. In his new position, Mr. Schirmer will manage all sales and contractual relations for his division in seven western states, Alaska and Hawaii. He formerly was contracting manager for Bethlehem.

Whitney C. Huntington has become associated with Harland Bartholomew and Associates, of St. Louis, Mo., as a consultant. He is a professor emeritus of the University of Illinois, where he served as head of the civil engineering department from 1926 until his retirement in 1956. As consultant with the firm Professor Huntington continues a lifelong interest in planning long-range improvement programs for universities and other institutions. He is an Honorary Member of the Society.

W. C. Huntington

Francis E. Csendes announces the opening of an office for the practice of civil engineering at 11 West 42nd St., New York City. Mr. Csendes specializes in airports and waterfront structures. He formerly was project engineer with Wyatt C. Hedrick, of Richmond, Va.

Whitney Ashbridge has been named assistant administrator for construction for the Veterans Administration in Washington, D. C. Mr. Ashbridge has recently returned from Venezuela where he was manager of the Frederick Snare Corporation's operations.

Brother B. Austin Barry recently represented the Society at the Ninth International Conference of Surveyors at Delft, Netherlands. At the conference Brother Barry read a paper on surveying and mapping. He is an associate professor of civil engineering at Manhattan College.

Thomas F. Thompson announces the opening of a consulting office at 503 Market St., San Francisco, Calif. Mr. Thomas, who specializes in engineering geology, formerly had an office at San Carlos, Calif.

Henry C. Beckman has received the Distinguished Service Award from the Department of the Interior in recognition of his "many years of outstanding administration of water resources investigation." Mr. Beckman recently retired from the U.S. Geological Survey Water Resources Division at Rolla, Mo.

K. L. Kollar and Gustavo Rivas-Mijares were recent co-winners of the Allied Chemical award given at the Sixth Congress of the Inter-American Association of Sanitary Engineers. The topic of their prize-winning paper was "Standards for Design and Construction of Rural Water Supplies." Mr. Kollar is a sanitary engineering consultant to the International Cooperation Administration, and Mr. Rivas-Mijares an engineer in the public health department of the I.C.A.

Eugene J. Peltier, chief of the U.S. Navy Bureau of Yards and Docks, Washington, D. C., has been promoted to the temporary rank of rear admiral.

Henry W. Fischer and Egbert R. Hardesty have become partners in the New York City consulting firm of Hardesty and Hanover. They were previously associate engineers with the firm.

Robert L. Moore has been elected an assistant secretary of the Lumbermens Mutual Casualty and American Motorists companies. Mr. Moore has been serving with the companies, which are owned by J. S. Kemper, since 1951. He was director of the technical and engineering division of the safety engineering department and superintendent of engineers.

Miguel Santiago-Melendez has been promoted from instructor to assistant professor on the engineering faculty at the College of Agriculture and Mechanic Arts of the University of Puerto Rico. Until his promotion, Professor Santiago-Melendez was in charge of the Materials Testing Laboratory at the University.

M. Santiago Melendez

Edgar F. Kaiser and Chad F. Calhoun, president and vice president of the Kaiser Industries Corporation, Oakland, Calif., have left on a trip to Accra, Ghana, at the invitation of Prime Minister Kwame Nkrumah. Messers. Kaiser and Calhoun will visit a proposed project site for a hydroelectric project on the Volta River and will inspect harbor, transportation, and communications facilities. They also plan to meet with Ghana government officials to discuss industrialization plans for the young republic.

(Continued on page 112)

MARS outstanding design **SERIES**

roll your own!

Speeding up our national road-building program is the goal of this design by Russ Henke of Elm Grove, Wisconsin. His behemoth of a machine literally chews up unmapped earth, compacts it with asphalt or macadam, stabilizes it, and lays a ribbon of paved road behind as it rumbles along! Crew and engineers ride in an air-conditioned cabin, and monitor the whole process by control instrumentation.

Tomorrow's *roads* may be squeezed out like toothpaste, but outstanding *ideas* for tomorrow are still produced in the old-fashioned, painstaking, human way. And only professionals know how the best in drafting tools can smooth the way from dream to practical project.

In pencils, of course, that means Mars, long the standard of professionals. Some outstanding new products have recently been added to the famous line of Mars-Technico push-button holders and leads, Lumograph pencils, and Tradition-Aquarell painting pencils. These include the Mars Pocket-Technico for field use; the efficient Mars lead sharpener and "Draftsman" pencil sharpener with the adjustable point-length feature; Mars Lumochrom, the color-drafting pencils and leads that make color-coding possible; the new Mars Non-Print pencils and leads that "drop out" your notes and sketches when drawings are reproduced.

The 2886 Mars-Lumograph drawing pencil, 19 degrees, EXEXB to 9H. The 1001 Mars-Technico push-button lead holder. 1904 Mars-Lumograph imported leads, 18 degrees, EXB to 9H. Mars-Lumochrom color-drafting pencil, 24 colors.

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3rd MARS Design Contest

HACKENSACK, N. J. – The MARS Outstanding Design Contests have uncovered numerous interesting designs which might otherwise never have been brought before technical audiences. They have attracted such wide interest that MARS Pencils is sponsoring another contest in 1959.

Russ Henke, Elm Grove, Wis., one of the winners in the 1958 MARS Contest. Mr. Henke's project, "Roll Your Own!", is featured in the MARS presentation on this page.

If you are an engineer, architect or student, the MARS contest offers you a "showcase." It provides you with a valuable opportunity to have projects you designed shown in leading magazines where they will be seen by the men in your profession.

$100 Awards

Send in your designs. Every winner will receive $100; winning entries will be reproduced in the wide list of technical publications in which the MARS Outstanding Design Series appears. There are no strings attached. You will be given full credit. All future rights to the design remain with you. You can reproduce it later wherever you like and sell or dispose of it as you wish.

The subject can be almost anything – aviation, space travel, autos, trains, buildings, engineering structures, household items, tools, machines, business equipment, etc. Projects will be selected on the basis of appeal to design-minded readers, broad interest, attractive presentation. Do not submit a design that is in production. The project, in fact, does not need to have been planned for actual execution. It should, however, be either feasible at present or a logical extension of current trends. It cannot be unrealistic or involve purely hypothetical alterations of natural laws.

The sooner you send in your entry, the greater the chance of its selection.

It is Simple To Submit a Design For Mars Outstanding Design Series

Just mail in an inexpensive photostat or photocopy of the subject – one you can spare, since it cannot be returned – and a brief description.

If your entry is accepted, we will ask for a clear illustration of your design in order to prepare a sharp rendering, or photograph suitable for reproduction. Your material will then be returned to you.

Send your entry to:

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Hackensack, New Jersey

DODGE BOOKS for active engineers and architects

FIELD INSPECTION OF BUILDING CONSTRUCTION

by Thomas H. McKaig, C.E., B.Arch.

A guide to the supervision of construction for engineers, architects, and field inspectors, this new book charts a clear path through the maze of owner-architect-engineer-contractor-subcontractor relations.

Defines and explains responsibilities for such matters as quality of materials and workmanship, coordination of work by different trades, schedules, safeguarding of work in place, safety precautions, and many more. Gives the inspector guidance in safeguarding the owner's interest against a variety of contingencies, without exposing him to charges and possible claims for interference or delay.

384 pages, 6 x 9″, $9.35

THE STRUCTURES OF EDUARDO TORROJA

an autobiography of engineering accomplishment

For the first time, the great Spanish architect-engineer describes and explains the major accomplishments of his career, and reveals with candor his unusual building philosophy. He selects 30 of his most significant structures — bridges, dams, hangars, sports arenas, factories, churches. Many, but not all of them, are of reinforced concrete, for Torroja's most unusual engineering feats are in prestressed and post-tensioned concrete.

The book shows the author's design reasoning behind each project, and gives many engineering details. There are over 275 photographs, plans and drawings.

208 pages, 7 x 9¾″, $8.50

THE CONTEMPORARY CURTAIN WALL

its Design, Fabrication and Erection

by William Dudley Hunt, Jr.

The first comprehensive work on this important construction system. Analyzes and evaluates curtain walls, their functions and malfunctions, their component parts, materials and installation.

Lists and tables give all presently known technical data including insulation efficiency, fire resistance, dimensional stability. Pitfalls are posted, and accepted good practice is specified. Amply illustrated with drawings and photographs.

468 pages, 7 x 9¾″, $12.75

ESTIMATING GENERAL CONSTRUCTION COSTS

2nd Edition

by Louis Dallavia

An accurate, foolproof method of estimating all direct production costs in earthmoving, concrete, masonry, steel, and timber construction. Cannot become out of date, and can be applied at any time and place with equal validity.

Presents an index set of unit costs for typical shift crews, against which you compare your own crews, arriving at a productivity percentage. By checking that figure against only three tables, you arrive at shift cost, output range, and unit cost, from which the complete job can be computed by simple arithmetic.

205 pages, 6 x 9″, $8.50

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CONSTRUCTION ACCOUNTING AND FINANCIAL MANAGEMENT

by William E. Coombs, C.P.A., Attorney

Here is a book which describes and specifically recommends proper accounting and management procedures for the construction industry. Tells you what records to keep, why they should be kept, and several possible ways of keeping them. Relates accounting and record keeping to the size of the firm and the type of job being contracted, and never loses sight of the fundamental purpose — giving you effective financial control over every operation.

488 pages, 6 x 9″, $12.85

STRUCTURES

by Pier Luigi Nervi

Drawing on his 30 years of experience, a great engineer and builder explores the potentialities and characteristics of reinforced concrete. He gives much valuable information on "Ferro-cemento", a type of reinforced concrete developed by the author and used by him in the construction of some of the largest and most beautiful thin-shell structures in the world. Fully illustrated.

118 pages, 7¼ x 9⅞″, $6.95

TIMBER DESIGN AND CONSTRUCTION HANDBOOK

prepared by Timber Engineering Company

The one sourcebook containing all the needed information for anyone concerned with wood design and construction. It is both a design reference and a practical field handbook. It was researched and written by 34 timber experts. Contains over 360 tables, charts, photographs and drawings.

622 pages, 6 x 9″, $12.75

APPLIED STRUCTURAL DESIGN OF BUILDINGS

by Thomas H. McKaig, C.E., B.Arch.

A practical office manual containing standardized procedures for solving structural design problems. Contains hundreds of short cuts, tables, design methods, formulae, sketches — a wealth of practical information. Every piece of data has been tested by actual use. Includes a detailed topical index.

444 pages, 7⅛ x 10″, $12.50

GROUNDS MAINTENANCE HANDBOOK

by Herbert S. Conover

The comprehensive guide for landscaping, maintaining, and planning of all types of grounds.

503 pages, 6 x 9″, $10.75

BUILDINGS FOR INDUSTRY

by the editors of Architectural Record

74 new industrial buildings are shown here, together with numerous studies on trends and factors in present-day industrial building design.

315 pages, 8¾ x 11⅛″, $9.75

A TREASURY OF CONTEMPORARY HOUSES

by the editors of Architectural Record

50 new houses, each depicted in ten or more photographs.

215 pages, 8¾ x 11⅛″, $5.95

HOW TO BUILD MODERN FURNITURE

by Mario Dal Fabbro

A complete manual of furniture construction. Includes clear plans for 53 pieces.

214 pages, 7 x 9¾″, $4.95

. . . . . *Am-Soc Briefs*

▶▶ Reclassification of member grades. . . . The regrading proposal was the major topic at the Society's annual business meeting held during Convention week. The proposed top grade of "Fellow" came in for some criticism, but a motion to ask the membership to choose between "Fellow" and "Senior Member" by letter ballot was decisively defeated. It was voted almost unanimously to send the reclassification proposal to the membership for ballot, in the form approved by the Board of Direction. It will be mailed on November 21. Votes must be in by January 23. The objective of the proposed changes is explained by the Task Committee on Classification of Members in "Society News," this issue.

▶▶ Practicing engineers are needed for accrediting work. . . . Don't leave ECPD's education and accreditation work entirely to the professors, Prof. F. C. Lindvall, chairman of the ECPD Education and Accreditation Committee, told engineers at an Annual Convention session on education sponsored by the Department of Conditions of Practice. In a first meeting of its kind, some 30 civil engineering inspectors on the Education and Accreditation Committee got together during the Convention to discuss how to do their work most effectively.

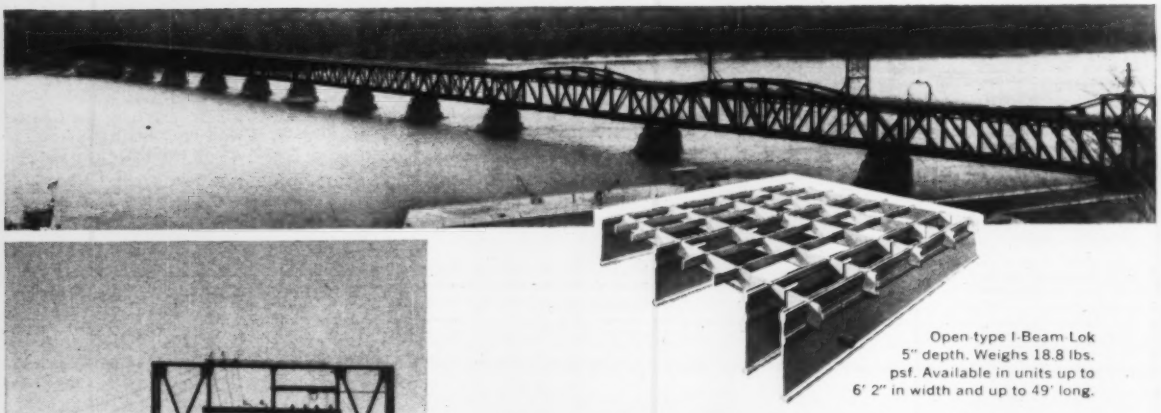
▶▶ A task committee finds surveyors are engineers. . . . This is the substance of conclusions of the Task Committee on Status of Surveying and Mapping, which submitted its third and final report to the Surveying and Mapping Division during the Convention. The committee recommended that persons wishing to engage in land surveying and related engineering work should at "an appropriate time in the future" be required to qualify for a professional engineer license. Brother B. Austin Barry was chairman of the Task Committee.

▶▶ The campaign for funds for the new United Engineering Center is rolling. . . . Once again (in Society News) gift totals are tallied by Zones, Districts, and Local Sections, and once again Zone I, District 4, and the Kentucky Section are ahead with their quotas. Gifts for the Center have come from Australia, England, Holland, Spain, Switzerland, Germany, Mexico, the Philippines, the Belgian Congo, the Netherlands Antilles, Canada, Hawaii, and Puerto Rico.

▶▶ Research in concrete. . . . One of ASCE's multiple cooperative activities included participation in the First National Conference on Fundamental Research in Plain Concrete, held at the University of Illinois this fall. Sponsors, in addition to the Society, were the American Concrete Institute, the National Science Foundation, the Portland Cement Association, the Reinforced Concrete Council, and the University. Up for study were the nature, structure, and behavior of concrete; chemical aspects; mechanical properties and failure; and failure and deterioration due to other than external load. Jackson Durkee and Josef Sorkin were in charge of the ASCE program.

▶▶ Since May 1956 there has been a steady and persistent increase in the annual increase of Society membership. The annual rate of growth for the year ending May 1956 was 600, and for the year ending in September 1958 it was 1,340. ASCE membership now stands at almost 42,000.

Reflooring with AmBridge I-BEAM-LOK gives old bridge new lease on life . . . lifts ban on big trucks



Open type I-Beam Lok 5" depth. Weighs 18.8 lbs. psf. Available in units up to 6' 2" in width and up to 49' long.

When the Keokuk Bridge Commission of Keokuk, Iowa, authorized the reflooring of the *repeatedly resurfaced* old timber floor on the bridge across the Mississippi River, their action resulted in far-reaching benefits. For not only did the new open I-Beam-Lok flooring provide a permanent all-weather floor that will *save a considerable amount in upkeep and snow removal*, but also, because it was lighter and stronger than the old floor, it was possible to lift the 10-ton weight limit which had long kept big trucks off this bridge.

Reflooring the 3,152-ft.-long x 18-ft.-wide bridge required approximately 59,000 sq. ft. of 5" TR-type open I-Beam-Lok.

While there is no way to determine accurately the weight of the old floor, built up with layer upon layer of various materials over the years, it seems certain that the weight saved in reflooring was at least three or four times the weight of the I-Beam-Lok itself—18.8 lbs. psf, or 567 tons in all. I-Beam-Lok, being steel, also greatly increased strength, literally giving the old bridge a new lease on life.

For information about the time- and money-saving advantages of this modern lightweight bridge flooring, ask for a copy of our 32-page catalog.

Keokuk Municipal Bridge
Keokuk Bridge Commission, Keokuk, Iowa

Designed by Modjeski and Masters, Harrisburg, Pa.

Contractors: The Whiting-Turner Contracting Company
Baltimore, Maryland

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American Bridge Division of USS United States Steel

General Offices: 525 William Penn Place, Pittsburgh, Pa. Contracting Offices in: Ambridge • Atlanta • Baltimore • Birmingham • Boston • Chicago • Cincinnati • Cleveland • Dallas • Denver Detroit • Elmira • Gary • Houston • Los Angeles • Memphis • Minneapolis • New York • Orange, Texas • Philadelphia • Pittsburgh • Portland, Ore. • Roanoke • St. Louis • San Francisco • Trenton United States Steel Export Company, New York

do you know that

Los Angeles continued to lead metropolitan areas in home-building last year? Despite a 10 percent drop to 80,700 units in 1957, Los Angeles is still our fastest-growing city. The New York-Northern New Jersey area, which yielded the top position to Los Angeles in 1953, continued in second place in 1957 with 66,300 units. The runners-up were Chicago, Detroit, and Philadelphia in that order.

• • •

Sooner than some think the United States must resort to the use of nuclear fuels? Twenty to twenty-five years is a reasonable guess, Dr. Norman Hilberry, director of the Argonne National Laboratory, said in an address at the recent Geneva Conference on Peaceful Uses of the Atom. Within fifteen to twenty years, he predicted, the public utilities of the United States must be generating four times as much electrical energy as they are generating today, and their costs are increasing.

• • •

The nation's largest solar furnace is now in operation? The Army has just dedicated a solar furnace, capable of producing temperatures of almost 5000 deg F, at its Quartermaster Research and Engineering Center at Natick, Mass. Designed for laboratory testing of Quartermaster materials for protection of the soldier against thermal effects of nuclear and other weapons, the furnace can intensify ordinary sunshine into temperatures approaching those generated by a nuclear blast. Its operating principle is optical and "relatively simple." The dedication ceremonies at Natick, on September 30, were followed by a two-day Symposium on Solar Energy.

• • •

Conflicting building codes are adding at least $1,000 to the cost of the average new house built this year? On our million new homes the annual bill for waste comes to a staggering $1 billion. Steps toward developing a more uniform residential building code were taken at a recent conference sponsored by the American Standards Association. A tentative code, drafted at the conference, has been submitted to the various member groups for study and vote by letter ballot.

• • •

Less than 25 percent of Canada's available water power resources has been developed? Though construction of hydroelectric facilities continued to accelerate in 1957 and 1,546,560 hp was brought into operation, total turbine installation at the end of 1957 is given as 19,891,008 hp. Source of these figures is Bulletin 2602, available from the Water Resources Branch, Department of Northern Affairs and National Resources, Ottawa.

Japan is building its first major toll road? The Nagoya-Kobe expressway, now under construction by the Japan Highway Public Corp., is part of a $2.5 billion road-building program set for completion in 1962. Japan is seeking to raise about $112,000,000 from sources outside the country, probably most of it from the United States. When the Nagoya-Kobe expressway is completed, it will be extended from Nagoya into Tokyo. The new toll road will serve a highly industrialized area that has 80 percent of the country's automobile and truck traffic.

• • •

The Soviet steel industry has extensive plans for expansion? Though its current output of 56,000,000 tons a year is only 40 percent that of the United States steel industry, the Soviet Union plans to increase its capacity to 70,000,000 tons by 1960 and to 125,000,000 by 1975. This report comes from the recent 19-man American delegation to the Soviet Union which covered 8,000 miles. It is the consensus of the group that in some phases of raw materials treatment and in blast furnace and open-hearth production, Soviet steelmaking compares favorably with the best to be found in our industry. Other phases of the Soviet industry, notably mining and some types of steel rolling, are said to lag considerably behind our standards.

• • •

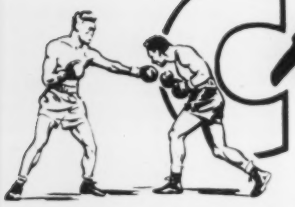
Almost 1,000,000 tons of steel a year go into the nation's roadbuilding program? About twice as much steel per mile goes into modern city highways as into rural roads, and the national average for all primary and interstate highways is about 500 tons per mile, according to the American Iron and Steel Institute.

• • •

The Niagara Power development will be one of the largest in the world? The $625,000,000 project, set for completion in 1962, will provide 2,190,000 kw of power. It will rank with Grand Coulee Dam as the one of the two largest hydroelectric installations in the Free World. The Niagara project will be financed by the sale of revenue bonds.

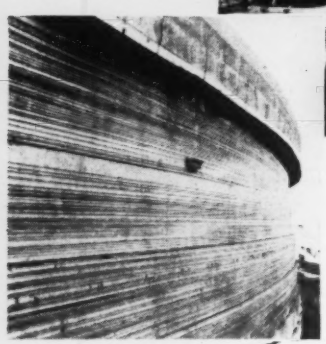
• • •

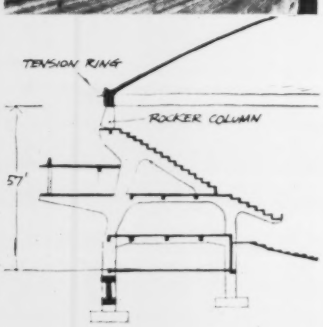
The number of engineering graduates in the U.S. is slowly inching up? In 1958 there were 35,000 bachelor graduates, and in 1959 the estimate is for 39,000. This is a forecast of the Engineering and Scientific Manpower Commission of Engineers Joint Council. The number of new civil engineers is expected to rise from 4,900 in 1958 to 5,300 in 1959.



Championship Material

1,146 WRAPS of prestressing wire on tension ring induced a compressive force of 14,000 lbs. per circumferential foot. Ring rests on rocker columns which absorb internal stresses and force of high velocity winds.





CROSS SECTION shows how monolithic dome and tension ring rest on hinged rocker columns, supported by stadium wall. Outer foundation is a 10' deep continuous ring girder.

Versatile Concrete Scores Victory in Cuba's Magnificent Sports Palace

● Five miles from the heart of Havana, in 65-acre Sports City, stands a monument to Progress as well as Athletics —Cuba's magnificent new Sports Palace.

Boasting the largest concrete dome in the Western Hemisphere—with 286' interior diameter—the building accommodates 18,000 spectators without a single pillar or post to block vision.

To absorb the stresses inherent in the flat shape of the dome (which rises only 40', or a 1:7 height-to-diameter ratio), and to withstand winds of hurricane force, the dome's perimeter connects with a prestressed concrete ring 3' thick and 5' high. This tension ring rests in turn on 24 reinforced concrete rocker columns, hinged top and bottom to absorb both internal and external stresses.

Ranking as one of the world's finest arenas, this project required 32,500 barrels of El Morro Cement, made by Lone Star's Cuban subsidiary, La Compañia Cubana de Cemento Portland. 28-day strength of dome concrete was 4,500 psi.

Owner: **COMISION NACIONAL de DEPORTES**
Architects: **ARROYO y MENÉNDEZ**, Havana
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CONSTRUCCIONES CODECO, S. A., Havana
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CIVIL ENGINEERING

Professional citizenship

FRANCIS S. FRIEL, President, ASCE, Albright and Friel, Inc., Consulting Engineers, Philadelphia, Pa.

Election to the presidency of the American Society of Civil Engineers is indeed an honor and a privilege. I am truly grateful for the confidence that has been placed in me. At the same time I must warn myself that it will be difficult to match the performance of my distinguished predecessors who have led the Society into its second century. But I will do my utmost.

Our certificates of membership in the American Society of Civil Engineers, like the passports of travelers abroad, are very important documents. They entitle the holders to rights and privileges but also impose upon them obligations and responsibilities. The extent to which a passport is honored by others depends both on the deportment of the individual who holds the passport and the stature and dignity of the society or state that issues it.

When you file an application for an American passport, the first questions you have to answer are, "Who are you and by what right do you claim this certificate of endorsement by the Government of the United States?" Your answer can be brief and to the point. A few simple documents attest the truth of your statements.

When you apply for the "passport" of the American Society of Civil Engineers you are asked the same questions, "Who are you and by what right do you claim the privileges of this membership certificate—this professional passport?" But while your initial answer to that question may also be reasonably brief, the full answer may take a lifetime, and it will be given not in words, but in performance—day in and day out, year after year, decade after decade.

President Francis S. Friel, left, is inducted into office as Louis R. Howson, right, becomes a past president.

The passport of the American Society of Civil Engineers imposes upon the person who acquires it a continuing obligation to share in the work of the Society. If this passport is to be honored, it implies—it requires—good professional citizenship. The passport holder is obligated to contribute personally to the enhancement of the practice of civil engineering both within and without the Society.

Since we are aware that there is true dignity in our profession, one unavoidable conclusion emerges. This dignity would be shattered by mediocrity; professional incompetence would make a mockery of our claim that what we are doing is worth while.

Today, too many people are smug and spoiled, addicted to easy living. Too many are concerned with a future four-day week. There is a dangerous drift toward mediocrity as the normal work standard. Our greatest natural resource, the youth of our country, needs as never before the sober supervision and wise counsel of their experienced elders.

During my forty years as a practicing engineer I have noticed a growing tendency which has been a source of considerable concern and puzzlement to me. It is this. While the facilities of education have progressively improved, and both the quality of instruction and the caliber of aspirants to the profession have risen, yet those who are entering the profession are characterized more than ever before by a general carelessness and a spirit of nonchalance. We must correct this attitude.

Getting back to the passports, the extent to which our passports are honored by others also depends upon the dignity and stature of our Society. If dignity is a function of age, we can proudly assert that the American Society of Civil Engineers is now 106 years old. If stature is a function of achievement, we can point to the significant role the Society has played and still plays in the development of our country. If dignity and stature are functions of size, the Society can point to its 70 Local Sections throughout the country, plus those in Alaska, Brazil, Colombia, Hawaii, Mexico, Panama, Puerto Rico, Venezuela; and to its membership of over 42,000.

The standing and the prestige of the profession are the sum total of the effectiveness and the standing of all its individual members. How can we have a proud profession if we do not all take pride in it? The strength of the American Society of Civil Engineers and the acceptability of its passport depend on the degree to which each member shares in the activities of the Society and, through his daily work, fulfills its aims and objectives.

Strength through unity

In a world of tension, the validity and acceptability of a passport often depend not only on the strength of the issuing country but on a greater strength derived from its alliance with other countries. The validity and acceptability of our ASCE passports can be greatly enhanced if we achieve—finally—an enduring alliance with the other professional engineering societies.

We have had no serious disagreements, rifts or quarrels among ourselves or with engineers in other fields that would leave a mark upon us, or upon these other groups. While this is true, it is also true that we have not yet been able to achieve completely the unity among the various professional societies which we all know to be desirable. We have not yet achieved or accomplished that grand alliance which will finally insure the highest authority for the passports we carry.

Other incoming presidents of the American Society of Civil Engineers have discussed this problem with you. So have outgoing presidents. We have all talked it over, we have worked on the problem, and I am pleased to say that progress has been made—good progress. We are now on the verge of achieving real unity for the engineering profession. It is my firm resolve during my term of office to promote this cause and to do all in my power to consummate it.

Our individuality as a Society is historic and is precious to us. We shall keep it. But what professional progress can the American Society of Civil Engineers alone achieve in improving the conditions of practice for civil engineers that will not be greater if we work more closely with other engineering organizations? It requires little imagination to sense the number of benefits that will accrue to each of the specialty engineering groups if they can be drawn together for the common good of all. This does not require the individual societies to lose their identity or to forfeit their activities. Rather they will continue their identity within a larger federation—a grand alliance—to insure joint action on technical and professional matters of benefit to the entire engineering profession and to the general public as well.

Unity through EJC

One of the elements operating against true unity is the idea that the interests of the engineering profession must necessarily be executed by three different agencies—first, technical; second, professional; and third, educational. This type of organization can hardly insure unity in the ranks. An ideal of unity would be a federation of such centralized authority and power that member organizations could refer to it every action of common interest, under such controlled conditions that, with rational give-and-take, the central body could be appointed to speak for the whole with one mighty voice.

We in the American Society of Civil Engineers strongly believe that unity can best be achieved through the Engineers' Joint Council. I urge a bigger role for EJC as a coordinating agency of inter-society activities. As a first step ECPD should merge with EJC.

A symbol of unity

Now causes need symbols, and a powerful symbol of unity in the engineering profession is available to us in the proposed United Engineering Center—the building to be constructed on the United Nations Plaza in New York. The need for such a building is pressing. When the present

building was dedicated in 1907, the Founder Societies had a membership of about 16,000. That building is now obsolete and inadequate. Today the combined membership of the Founder Societies is over 179,000. In addition there are more than 66,000 members in the twelve Associate Societies and organizations which are requesting space in the new Center. These figures do not include the more than 36,000 student members of the various societies. (The total is 281,000.)

The United Engineering Center is essential if the engineering societies are to continue to keep pace with the tremendous growth of the engineering profession in this scientific and technical age in which we live. The new Center will cost ten million dollars. That is a lot of money—but for a fine cause. Two million is available from assets of the United Engineering Trustees. Five million is sought from business and industry. And three million is to come from us all as members of the participating Societies.

The share accepted by the American Society of Civil Engineers in this effort is $800,000; of this, about $145,000 has already been raised. It will be my prime concern to see that our Society completes its share. In this effort I know I can count on the warm support of each and every one of you.

We can be thankful for the noteworthy achievements of the industrial appeal which has already brought in about $3,650,000.

Two to three years from now our Society and the entire engineering fraternity can have a new building of which we can all be proud, and that new building will stand as a symbol of our strength and unity in much the same way that an embassy is representative of its country. I need not remind you how important an adequate and efficient embassy is to passport-bearing citizens abroad. A fine and functional embassy also promotes good public relations for its country. In all these respects the new headquarters for our engineering organizations will better serve all passport-bearing engineers.

An itinerary for the future

Valuing our passports, it behooves us to ask: Where are we going? What is our destination? We live in an age of wonders, in a time of great discovery, infinite daring, and unpredictable danger. It is no longer enough for us as civil engineers to use our talents only to conceive and build as others dictate. We must use our skill and imagination to determine how best our local, regional, and national—indeed international—problems can be solved. We have not only the right, but the moral obligation to express our opinions and make ourselves heard. The certificates of our profession, our passports from this Society, give us authority to speak for the profession we represent.

One of the most challenging problems today facing the professions and industry is the development of leaders for the future. Well-trained men are urgently needed in both the technical and the management fields. Future leaders will be drawn in increasing numbers from the ranks of these well-trained men. The American Society of Civil Engineers will do its part in furnishing these men.

We must recognize the march of progress which is constantly under way in the world and we must recognize that, if we cease to advance with the group, we will in effect be lagging behind.

The problems ahead are many. One is traffic. As we improve and increase our means of transportation, traffic becomes a menace which threatens to choke the life out of our great urban centers. The answer may lie in multi-level streets and highways, or in improved public transportation. Whatever the answer, it is up to us as civil engineers to find it.

Water supply, both in this country and in many other countries whose fate we shall ultimately share, is being depleted and in some regions has been tragically wasted. Water is the key to the economic growth of our country. The entire future of certain areas depends upon the effectiveness of the planning for the conservation and use of water resources. We must guard and control the old sources and find new ones. It is part of our responsibility to see that no one need be hungry or thirsty from lack of water. We insist that the fruitfulness of the earth and the productivity of industry endure. Also, flood control remains a great unfinished project that must be completed.

Social implications

These are some of our familiar daily problems; there are newer and more challenging problems before us. In his work of construction, the civil engineer today must consider effects other than those of simple physical stresses and strains on his materials. It is no longer enough to know how to construct a dam that will hold water, and let it go at that. We must consider carefully the social and political implications of all our works.

The civil engineer may some day be required to work on problems of construction in locations where our concept of gravity will be strangely modified. But before we engage in that activity we must be sure that we are ready for such advances.

Before we can build bridges on the moon, we must necessarily build bridges of understanding among men. We are now beginning to better understand the forces of nature as we are harnessing nuclear and solar power. But isn't the first requisite that we learn to measure and harness our own emotions?

We are now sending powerful missiles into space, but shouldn't we first learn to make them truly guided missiles? We must know where we are going and why—to know *how* is not enough.

We must not allow our precious passports to become passports to oblivion. They must be passports to a new and better world for all mankind.

A vast amount of unfinished business is before the civil engineer and also before our Society. Our members will do their part and meet the challenge. We have a special responsibility to contribute to the public welfare. I hope we will all accept our responsibilities and enjoy our privileges. We dare not rest on our laurels. We must aspire to make the American Society of Civil Engineers an even better Society than it is today.

Deep foundations in soft Chicago clay

EDWARD E. WHITE, M.ASCE, Executive Vice-President, Spencer, White & Prentis, Inc., New York, N. Y.

Good ground makes good construction men," a saying well known to men who work underground, does not apply in Chicago, where the ground is poor and all classes of foundation engineers and construction men have had trouble in subsurface work. But in this bad ground new methods of construction have proved successful and recent determinations of actual earth pressures have disproved some long held theories.

That part of downtown Chicago called "the Loop" generally has a 10-ft upper layer of hauled-in granular fill placed over an original lake bottom of stiff blue and yellow clay. Under this crust there is about 40 ft of soft clay grading from an unconfined compressive strength of 0.3 tons per sq ft to 0.7 tons per sq ft. Next comes a 40-ft layer of stiff clay and hardpan and below that bedrock. The soft clay layer has been the basic cause of difficulty in Chicago and has made this city of interest to foundation engineers all over the world—along with other cities with difficult ground, such as Mexico City, London, and New Orleans.

Until recent years deep excavations for buildings were accomplished by excavating for the exterior foundation walls in deep trenches. After completion of the peripheral wall, the general excavation proceeded simultaneously with bracing of the foundation walls. This method, although expensive, had the advantage of safety.

This procedure was modified first in the open-cut subways constructed in Chicago in 1939 to 1941, built with braced steel sheetpiling or with soldier beams holding horizontal timber sheeting for support of the clay banks during excavation. No major buildings were put up in downtown Chicago from the early 1930's until after World War II.

It is only recently that several large structures with deep basements have been planned in the Loop area. Two of these structures are the Harris Trust Building now under construction and the Inland Steel Building completed in 1957, two blocks away in similar soil. The constructors departed from the old Chicago method of building the walls in trenches and instead built the foundations by excavation in a large open sheetpile cofferdam in which the entire foundation was constructed.

The Harris Trust excavation is 104 ft × 200 ft and 46.5 ft deep, penetrating into soft Chicago clay (Fig. 1). The building is supported on 46 Drilled-In caissons consisting of pipe cylinders of 30-in. outside diameter and ½-in. wall thickness driven open-end to rock. After they were cleaned out, a socket 6 ft deep of 30-in. diameter was drilled into the rock, which is identified as Niagara limestone. A heavy 14-in. wide-flange steel core is inserted through the cylinder into the rock socket and concreted in place, providing a fixed-end column socketed into the limestone bedrock. These units carry as much as 1,350 tons per caisson and are designed for higher unit stresses than had been used before this installation. Stresses are 12,000 psi on the steel shell, 16,000 psi on the core, and 1,650 psi on the 5,000-psi concrete specified. Rock bond was computed at 250 psi.

Although Drilled-In caissons have been used in many parts of the United States and Canada, this is the first use for a major structure in Chicago. This installation was decided on when a test Chicago-type caisson disclosed a large amount of water in the hardpan and over the rock. It is very risky to install the standard Chicago caissons where loss of ground will affect adjacent structures. The Chicago caisson is an open circular pier, usually 4 ft in diameter, excavated by hand into the clay in 5-ft 4-in. increments, after which 2-in. wood sheathing is positioned vertically along the clay sides and braced by two sets of steel channel rings. In recent months there have been several open-caisson jobs that have seriously affected buildings nearby, making local engineers very conscious of the deficiencies of this type of foundation.

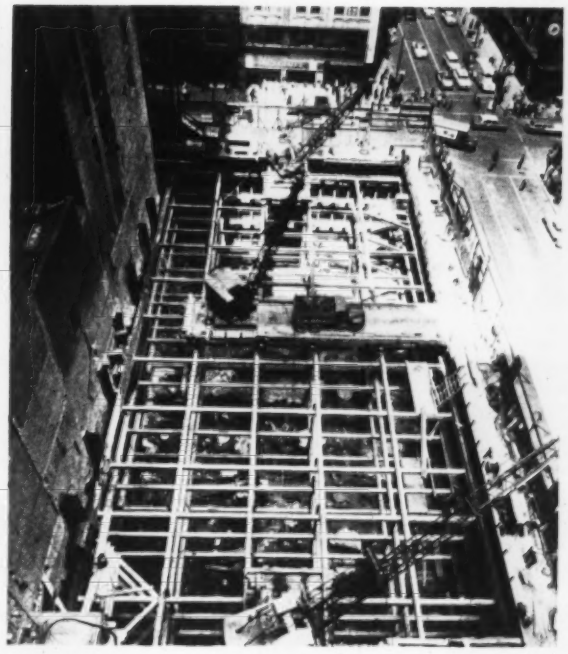
The presence of water was borne out in the Drilled-In caisson installation, since only a few caissons could be pumped out for inspection. The others were sealed by placing concrete under water by tremie bucket and lowering the steel core into the concrete before it sets. The caissons were then pumped out and the concreting completed in the dry. This procedure eliminated the general-area pumping which has been a cause of settlement of adjacent structures in Chicago.

Drilled-In caissons were installed from the old cellar level about 15 ft below the street level, because it would have been too difficult to work at the 46.5-ft subgrade depth through a bracing system. The 30-in open-end steel casings, installed by pile driving methods to hardpan, were excavated with earth augers, then drilled through hardpan to rock by Bucyrus Erie cable drilling rigs. Positioning of the Drilled-In caissons at the corrrect theoretical column locations had to be accurately executed as they were installed about 30 ft above subgrade. Timber templates were used at the ground surface to start the caissons, and the cylinders were carefully driven. Following excavation to subgrade, only 6 of the 46 caissons were found to exceed the permitted tolerance of 1½ in. from correct location, and these only by a slight amount. The eccentricity of these caissons was easily corrected by increasing the reinforcing in tie-beams between caissons.

After the caissons were installed, the deep excavation was sheeted and braced by a system of soldier beams, horizontal louvered wood sheeting, steel braces and walers. Soldier beams consisting of 18 WF 96 sections were driven 6 ft on centers into the hardpan. As excavation proceeded, second-hand 3-in. timber sheeting was placed horizontally 3 in. behind the back flanges of the soldier beams.

The 18-in. soldier beams were encased in a concrete wall 2 ft 2 in. thick, the soldier beams serving the multiple functions of providing temporary support for the excavation and also supporting and reinforcing the permanent concrete wall of the building. See Fig. 2. The timber sheeting provided a back form for the concrete wall as well as a support for the clay. Several feet of excavation and backfill were saved as compared with the conventional method where the soldier beams are used only for temporary support.

Here however, this method of construction, used very successfully on other structures in good granular material, resulted in a larger amount of settlement of the street than occurred at



↑ Sticky clay was pulled out by a Gradall hydraulic crane to where clamshell could pick it up from above. Note detail of bracing and the Drilled-In caissons.

← In foundation excavation for Harris Trust Building in Chicago, three tiers of braces have been installed. Stress on upper braces was found to be more than the usual theory indicates while lower braces carried less.

→ Strain gages gave accurate record of stresses in each cross-lot brace.

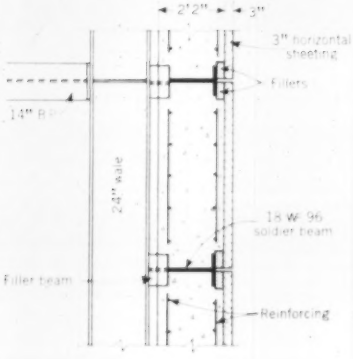
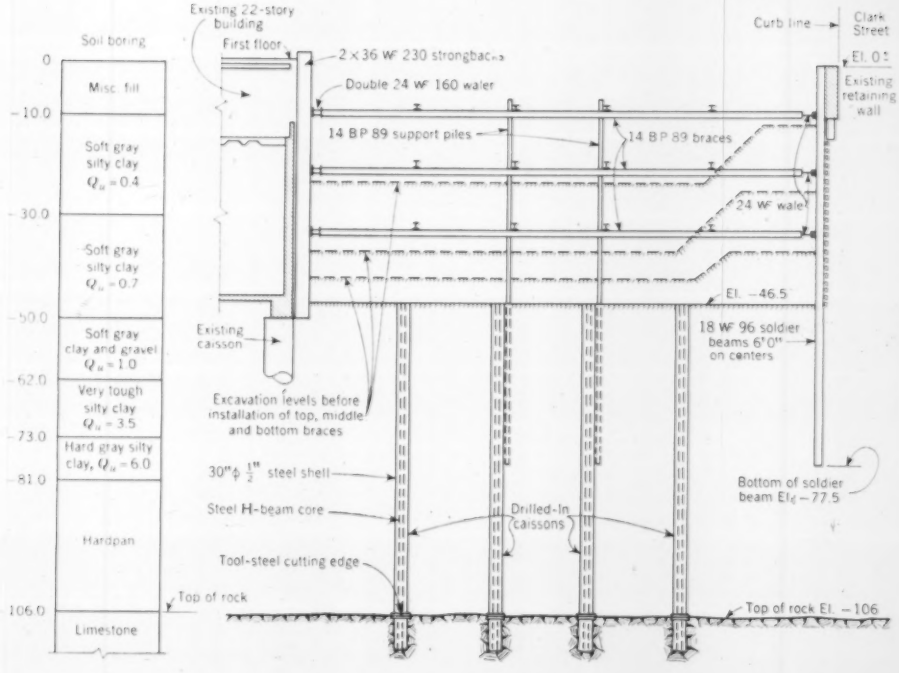


FIG. 2. View looking down on exterior wall shows how horizontal 3-in. sheeting was fitted behind soldier beams and left to hold out earth and make exterior form for concrete.

FIG. 1. Typical section across center of building gives excavation levels before installation of top, middle and bottom bracing. Drilled-In caissons were installed before excavation was made for middle braces.



the nearby Inland Steel Company building, where the horizontal sheeting was placed between the front flanges of the soldier beams rather than 3 in. back of these beams. Flow from a great number of leaking water and sewer lines caused much of the settlement. Excavating to install the horizontal sheeting behind the beams on the Harris Trust job destroyed the arching effect of the clay. A much greater load was placed on the sheeting, and in some cases this caused breakage and distress. As a consequence the size of the wood sheeting was increased to 4 in. at the 35-ft depth. On the Inland Steel job, where the sheeting was placed on the front flange and the clay formed an arch between the soldier beams within the flanges of the beams, there was no distress in the 3-in. boards and street settlement was negligible. At Inland Steel the leakage from utilities also was negligible.

The soldier beams were braced by three tiers of 24-in. horizontal steel walers and 14-in. BP 89 steel cross-lot braces spaced 18 ft on centers. Design of such sheeting and bracing is not easy to formulate because of the many conflicting earth-pressure theories. Observations indicated that there is much more to be learned about soil pressures.

Estimates of the soil pressure against the sides of the cut made by different engineers ranged from a low of 20 tons per lin ft of excavation 46.5 ft deep to a high of 65 tons per lin ft. There was also a wide range of opinion as to the distribution of pressure against the cut, varying from an equivalent hydrostatic distribution to the trapezoidal form of Peck and Terzaghi. It was decided to use a total load of 30 tons per lin ft for excavation 46.5 ft deep with the pressure distributed in a trapezoidal form, using 1.7 kips per sq ft as the maximum unit pressure. This criterion was based on experiments and formulas developed by Dr. Ralph Peck, M.ASCE, on the Chicago subway, and also from measurements on braces conducted by Spencer White & Prentis on the Inland Steel Building in the same type of material. The waler steel was designed for a unit working stress of 24,000 psi and the braces for 18,000 psi, reduced by the length factor.

Because of uncertainty as to the amount and distribution of pressures to be carried by the bracing system, a careful check of stresses in the braces was made during excavation using both electrical and mechanical gages. The stress is affected by the method of excavation and installation. The brief description of construction procedure here given will aid in evaluating the data available.

Three trestles were built over the open area to provide access for the large cranes that excavated the clay, using clamshell buckets, and handled the steel bracing. These trestles were built of steel girders carrying a 12-in. timber deck. The trestle was supported on bearing piles, which were fastened to the horizontal bracing to stabilize the high structure.

The Chicago clay has the characteristic of being not only soft but very sticky; it will stand up in narrow windrows or pinnacles under braces and walers, defying the efforts of the crane operator to remove them mechanically by clamshell. These windrows have in the past been cut out by hand labor and placed in piles accessible to clamshell buckets, a very expensive operation in Chicago where laborers receive $25 a day exclusive of insurance and the like. The clay is too soft to support crawler-mounted bulldozers, which quickly bog down.

At the Harris Trust job this hand work was eliminated by using crawler-mounted Gradall excavators working on wooden mats. These rigs use telescoping hydraulic booms and therefore can do a great deal of work from one place, minimizing disturbance of the clay on which they rest.

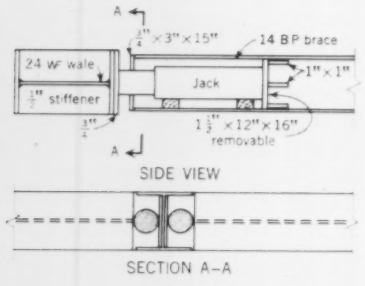


FIG. 3. In detail of pretesting assembly, two jacks react against the removable plate. Wedges placed at end of brace take load to release jacks.

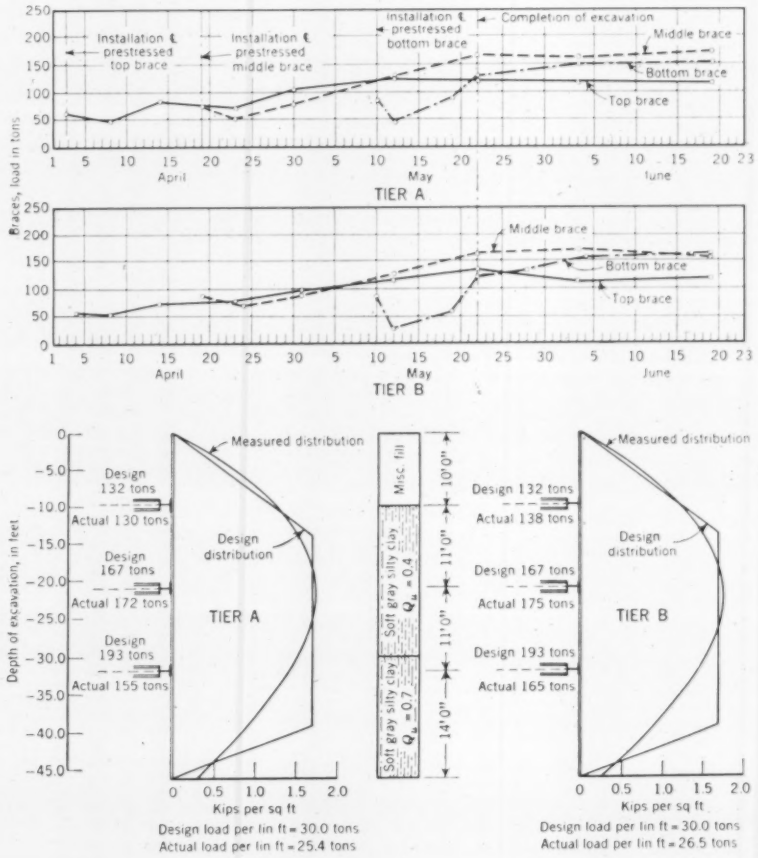


FIG. 4. Stresses in cross-lot bracing are indicated as determined by strain gages on two central tiers of bracing. The strain gages gave a different distribution of stress from that computed by conventional formulas.

The Gradalls cut the clay under the braces, walers, trestles and between the soldier piles and eliminated practically all the hand work experienced in previous work. Progress was speeded up to the point where 30,000 cu yd of clay was excavated in a two-week period, including the time for installation of horizontal sheeting and the bracing.

A definite plan for excavating and sequence for placing of bracing was established, with the clay excavated about 12 ft below the first tier of braces at the center of the excavation, leaving wide berms on a 1:1 slope, the slope starting 10 ft from the sheeting line. After the first-step excavation had been made to the prescribed grades and slope, the steel bracing was installed for an entire tier and prestressed to about 50 percent of the design load using two hydraulic jacks of $4\frac{1}{2}$-in. diameter at a brace. The jacks operated at a pressure of about 2,500 to 3,000 psi. Jacks were placed between the flanges of the brace, reacting against a removable plate bearing on three 1 × 1 × 4-in. bars welded to the inside of the web and flange. The load was transferred from the jacks to the brace by means of wedges placed at the end of the brace. See Fig. 3.

Stresses in the steel cross-lot bracing were continuously measured and gave an excellent picture of the action of the bracing system. The graph, Fig. 4, indicates how the pressures increased as the excavation progressed. The electrical strain gages were not too satisfactory as they were ultimately affected by the weather, and Whittmore strain gages were used for the duration of the excavation operation.

A comparison of the readings of the measured loads with the design loads (Fig. 5) indicated that there was generally slightly less load per foot of cut than designed for. However the distribution was not in accordance with the design criteria: the top brace received more load than that for which it was designed, and the bottom braces less load. This situation probably is due to the fact that the top braces are the first ones installed and have to be the sole supporting members for the adjacent earth before the last brace is installed. Measurements on other excavations seem to bear out these results, which are contrary to the old Rankine theory, according to which the bottom braces develop the greatest loads.

Strain-gage readings disclosed that the prestress load was dissipated in the clay in about a day, with only about 50 percent of the prestress load remaining in the brace. Temperature changes did not have very much effect on the loads in the braces as added loads due to increased temperature apparently were also dissipated in the clay.

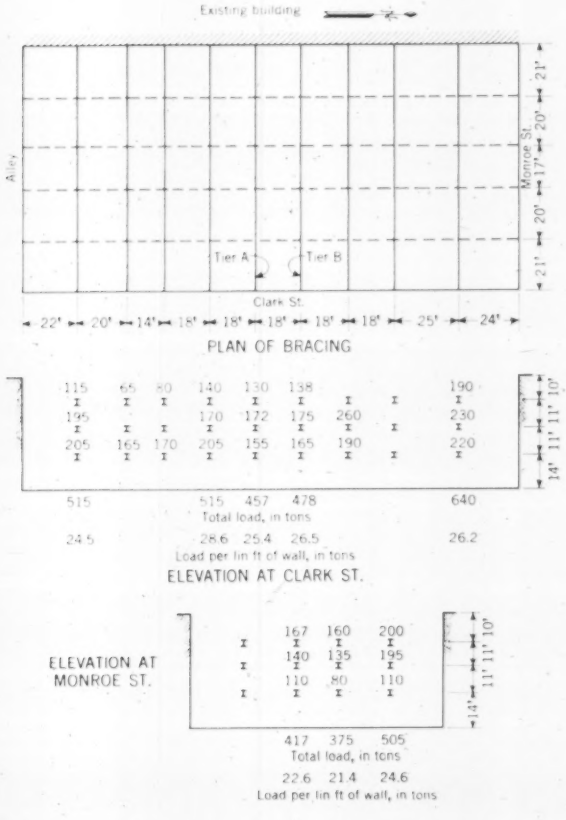
This situation was changed however when subgrade was reached and the first 22 ft of the concrete basement wall was in place. The concrete wall encased the soldier beams and provided a solid reaction against the sheeting for the braces. The stress in the third tier of bracing then varied with the change in temperature. On a hot July day the load on one brace built up to 290 tons, or 50 percent more than the design load, necessitating installation of another brace. This stress build-up could be alleviated by pouring the concrete floor before concreting the walls, thus relieving the pressure on the lower tier of braces.

The Inland Steel and Harris Trust foundations are of great value in giving a better understanding of how to work in Chicago clays. One of the most important results is the value of strain-gage measurements during construction and careful surveys of streets, adjacent buildings, and sheeting lines. These measurements gave the engineers an invaluable understanding of the earth pressures involved.

Soil mechanics theory is so often based on small-scale laboratory tests, which are often erroneous, that these large-scale tests can do much to advance the science of foundation engineering. It should be standard procedure in large installations of this type to make these measurements and to share them with the engineering profession.

The Harris Trust Building was designed by Skidmore, Owings & Merrill, architects and engineers, represented at the site by David Dubin. Turner Construction Company is the general contractor, for which Clinton Hernandez, M.ASCE, is Chicago Manager; Charles Powell is general superintendent; and George Wheeler is Project Superintendent. Spencer, White & Prentis was the foundation subcontractor, with M. J. Muldowney as Job Superintendent and Max Schaub, Job Engineer, under the direction of Donald McKinley, A.M.ASCE, General Superintendent. Ralph Peck, M.ASCE, served as Soil Mechanics Consultant for Spencer, White & Prentis.

FIG. 5. Maximum loads on the braces were measured after completion of excavation and before concreting.



TWIN DOCK-SIDE TRANSIT SHEDS for San Diego

JOACHIM E. LIEBMANN, M.ASCE, Chief Engineer, Port of San Diego, Calif.
GREER W. FERVER, M.ASCE, Consulting Engineer, San Diego, Calif.

Steel-frame structures of nearly 400,000 sq ft, fire and earthquake resistant, were built on soft fill for $4.86 per sq ft

Each of San Diego's twin transit sheds, shown here under construction, are 200 ft wide and 964 ft long, divided into four areas each 240 ft in length. Shoreward lie 43 acres of tideland available for cargo storage development. Marginal-type wharf about a half mile long permits simultaneous berthing of nine ocean-going ships.

Twin transit sheds, providing nearly 400,000 sq ft of covered storage area, are features of the new $9.5 million Tenth Avenue Marine Terminal in San Diego, Calif., nearing completion this fall. The two buildings are designed to economically meet the stringent requirement of the Cotton Warehouse Inspection Service for Class A buildings. Each shed is 200 ft wide between side walls and 964 ft long, divided by fire walls into four rooms, each 240 ft long.

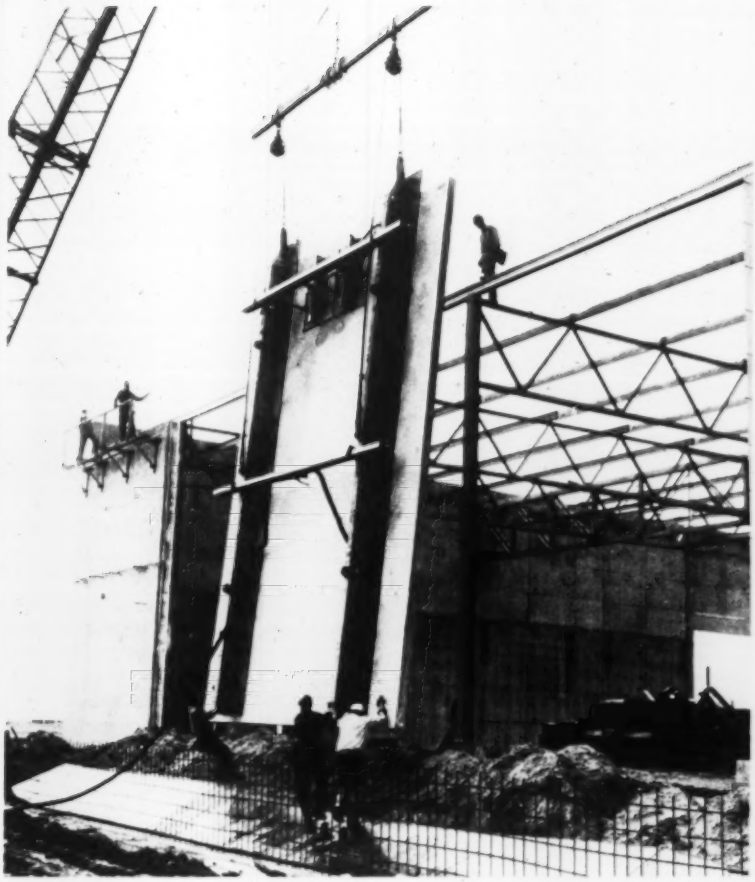
A marginal-type wharf was chosen in preference to two equivalent finger piers. Approximately one-half mile long and extending 1,000 ft from the bulkhead to the pierhead line, the wharf permits simultaneous berthing of nine ocean-going cargo ships. Shoreward lie another 43 acres of tidelands which later will be developed for open or bulk cargo storage. Sites have been reserved for the future construction of two warehouses to provide 600,000 sq ft of additional storage space.

A firm sand and clay bottom permitted use of gravity-type quay wall which provides an adjacent water depth of 37 ft. This massive wall in cross-section resembles a gravity dam with a vertical face and a 1:1 back slope. It was constructed by the under-water placement of rocks weighing as much as 7 tons, and portland cement concrete. About 2 million cu yd of dredged hydraulic fill was pumped behind the completed wall.

The pier embodies a number of innovations and other notable features which include unusually wide dock-side aprons and spacious loading areas, and provision for simultaneous fueling of cargo ships and discharge of water ballast while cargo is being loaded and discharged. Tubular rubber fenders take the place of the creosoted wood fender system commonly employed. An elaborate and flexible underground electric power distribution net and communication system is based on the installation of one primary electric power meter for the entire terminal.

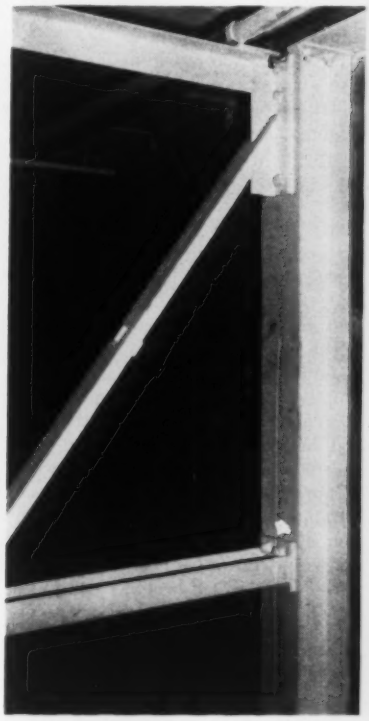
Except for minor details, the two transit sheds are alike. Columns are spaced at 60-ft intervals along the length of the building and are located to provide a 100-ft center aisle with two 50-ft side aisles. (See Fig. 1.) This wide column affords a minimum of interference with traffic and also gives great flexibility of arrangement for storage purposes.

Division walls between rooms are 12 in. thick to provide protection against the spread of fire. They extend 5 ft above the roof and are returned 20 ft in each direction at the side walls. End walls are 8 in. thick. Precast longitudinal side-wall panels are of concrete 6 in. thick and were put into position by a crane. Doors of roll-up type are located in the center of each transverse



Vacuum-grip device with equalizing pick-up enables crane to handle 20 X 28-ft concrete wall panel without overstressing. Panels rest on grade beam and are held against steel columns by stud bolts welded to columns.

Design stresses were determined on basis of simple end connections, but after all dead loads were in place, both chords of all trusses were connected to make them fully continuous. Also roof trusses were connected at both chords to side-wall columns as shown.



wall and in every other bay of the two long side walls, except at the fire-wall returns. Doors along the land side open onto a loading dock 15 ft wide.

Shed roofs of poured-in-place gypsum are carried on steel purlins and steel roof trusses. Clear height under the trusses is 20 ft at the land side and 22 ft at the water side. The gypsum roof is waterproofed with a 15-year bonded built-up roof with crushed-rock topping.

In view of some expected settlement of the newly dredged fill, a flexible type of interior pavement was chosen. It consists of a base course 9 in. thick, of crusher-run aggregate, and an asphaltic concrete surface course 3-in. thick, of 40 to 50 penetration. This was finished with a double squeegee application of jet-fuel-resistant seal to fill surface voids and afford maximum protection against solvents.

The buildings have no skylights or

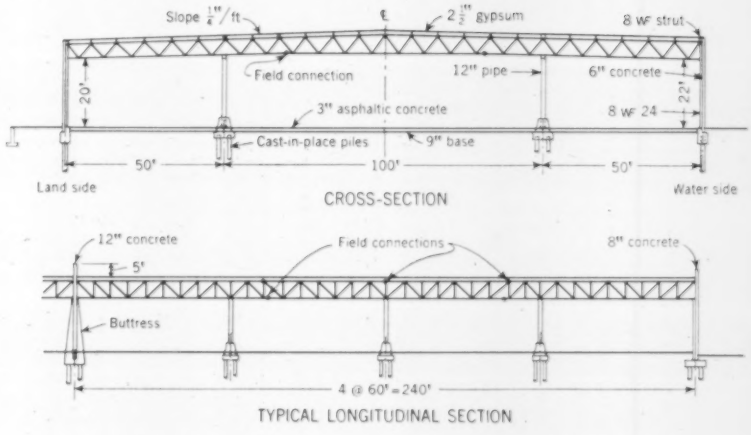


FIG. 1. Columns are spaced at 60-ft intervals along length of building and are located to provide a 100-ft center aisle and two 50-ft side aisles. Wide column spacing yields greater flexibility of arrangement for storage purposes.

monitors and, except for cargo checkers' offices and toilet rooms, are completely without windows. It was felt that, if used at all, enough skylights and windows should be installed to make unnecessary the use of artificial light during normal daylight hours. Such daylighting would not only be a costly item but would interfere with the action of the roof diaphragm and would require additional lateral roof bracing. Instead, plans call for a fluorescent lighting system which is expected to give a minimum light intensity of 7 ft-candles at floor level.

Provisions were made in the roof of each compartment for the future installation of four power vents. The buildings are sprinklered throughout. Longshoremen's toilets and transformer vaults are located at regular intervals on the water side of the buildings. Above these are the offices for cargo checkers. These interior structures are of concrete block for the first story with concrete-slab second floors and wood stud and plaster for the second story.

The requirement for a Cotton Warehouse Inspection Service rating of Class A was a controlling factor in limiting room areas, in determining the thickness and height of fire walls, in selecting concrete for exterior walls, in the use of sprinklers throughout, and in determining the size, number, and location of openings. On the basis of experience with other buildings in the harbor area, it had been decided to use a steel roof-supporting structure to obtain the long spans required with a minimum dead load.

Since speed of construction was an important factor, it was decided to let a separate structural-steel contract so that the steel would be ready for erection as soon as the foundations and main walls had been constructed. Before the steel design could be carried out, however, it was necessary to decide what the roof deck would be and how best to handle earthquake loadings.

Records indicate that San Diego has several times been shaken by earthquakes of remote origin. Earthquake intensities of about 6 on the modified Mercalli scale have been recorded and an intensity of about 7 is probably the greatest in recorded history. Old buildings in San Diego that have obviously never endured a major shake indicate that none has been experienced in the past 60 or 70 years. Common sense and experience elsewhere dictate, however, that such records do not preclude the possibility of a major disturbance.

Accelerations are thought to be much higher during many earthquakes than those prescribed by the Uniform Building Code. It is believed that one of the most important reasons structures successfully resist these accelerations is because they have ability to absorb energy internally by friction between the parts, by elastic deformations, or by plastic deformations not causing structural failure, so that they can damp impressed vibrations and thus minimize or escape damage. Other important considerations in the ability of a structure to resist seismic action are the type of soil and foundations under it and the relationship between the frequency of the ground vibration and the response frequency of the building.

An examination of the proposed plan of the sheds indicated that the transverse fire walls and end walls would provide very strong resistance against transverse horizontal forces. Also, the required returns at the ends of these walls could be used to resist longitudinal forces. Because of the considerable length of the buildings and the possibility of differential settlements along the side walls it was not believed desirable to make the side walls structurally continuous, especially since it was not necessary to use them to resist longitudinal forces. If the transverse walls with their end returns were to resist all seismic forces, means would be needed to transmit the reactions of the roof and side walls to these walls. There are various ways of doing this, but usually the easiest and most economical way is to design the roof deck as a diaphragm to distribute horizontal forces in shear.

In selecting the roof-deck material then, the following criteria were considered:

1. Strength to transmit horizontal forces
2. Good vibration damping ability
3. Fire resistance
4. Light weight to minimize both seismic and foundation loads
5. A reasonable first cost and low maintenance cost
6. Ease of insulation or ability to afford some measure of thermal insulation of itself
7. Availability and speed of installation

Several types of roof deck were considered, including plywood, steel deck, lightweight concrete, and poured-in-place gypsum. The gypsum deck was chosen because it best fulfilled the requirements. The "Report on Tests of Poured Gypsum as a Horizontal Diaphragm," prepared by S. B. Barnes, M. ASCE, Structural Engineer of Los Angeles, indicates that gypsum can be used at a much higher shear value than is allowed by the Uniform Building Code and that it performs well under dynamic loading. Its fire resistance has been shown by tests and experience.

As designed, the gypsum roof consists of a 2-in. poured fill over sheetrock from board ½ in. thick, reinforced with 6 x 6, 10/10 galvanized wire mesh. The boards are laid between steel-bulb tees which in turn are welded to the roof purlins 32 in. on centers. Purlins are 8 ft 4 in. on centers and are so connected as to act continuously for the full length of each room.

The gypsum is heavily doweled into the transverse walls and is anchored to 8-in. wide-flange struts extending continuously along each edge of the roof. The struts in turn are anchored to the returns of the transverse walls, so that they act to transmit longitudinal forces to the walls directly and also as chords of the diaphragm for forces acting transversely.

An acceleration of 20 percent, instead of the 13.3 percent stipulated by the Uniform Building Code, was used for the design of the roof and for the building as a whole. This reflected the designers' anxiety concerning site conditions and the probable reaction of the structure to seismic vibrations. Interestingly enough, the increase in seismic factor had little effect on the cost of the building.

Once the roof material was selected, attention was turned to completing the design of the structural steel. Column locations were determined on the basis of building use, and these in turn determined truss spans. Trusses were arranged to use a combination of cantilevered spans supporting huge spans so that positive and negative bending moments would be balanced. Carrying trusses were supported at all transverse walls. Intermediate columns were required by the Harbor Department to be pipe of 12-in. diameter, concrete filled for protection against damage if struck by the heavy fork-lift trucks used to transport the baled cotton. Steel columns were provided at the side walls so that the structural steel could be erected ahead of the walls and also so that the side walls would be structurally independent of the building.

A noteworthy feature of the steel design is an adaptation of what the Navy calls "slanted design," now required for many Navy projects and aimed at improving blast resistance. All trusses were first simply connected to each other and to the columns, and design stresses were determined on the basis of these simple end connections. Later, after all dead loads were in place, including the gypsum deck, the tar and gravel roof, and the sprinkler system, both chords of all trusses were connected to make them fully continuous, and roof trusses were connected at both chords to side-wall columns.

By this means a considerable reserve strength is obtained at small cost. At

the same time, the design difficulties and uncertainties involved in proportioning continuous trusses are avoided.

Total weight of steel for the job was 1,047 tons, or 5.4 psf.

While the structural steel design was being completed and prepared for bidding, the problems of constructing the buildings on newly dredged fill were studied. The area is underlain by ancient compressed sediments of great depth and of high bearing value, the topmost layer being a hard brown clay of varying thickness. These ancient sediments have been covered along the shore by more recent sedimentary deposits. The site of the pier is at the mouth of a creek where the alternating erosion and deposition resulting from the discharge of flood waters have resulted in a highly irregular deposit, as is the case with other streams entering San Diego Bay. At the site the bay bottom was covered with from 3 to 5 ft of very soft mud.

Dredged fill had already been placed over part of the pier area directly over the mud. This fill, taken from further out in the bay, consisted of sandy material which contained some clay and occasional inclusions of gravel and shells. These sands were well interspersed with clay balls picked up when the dredge cutter worked into the hard clays below the sand.

Test piles were driven in the fill near the building site soon after it was deposited. Monthly surveys of the elevation of these piles indicated that a slow but steady settlement was occurring on the order of ½ to 1 in. per year. This is believed to be caused both by compaction of the sands placed under water and by compression of the layer of soft mud.

Pile foundations were an obvious solution to the problem but piles are expensive. It was felt that if clean sand could be obtained for the rest of the fill, which encompased most of the actual building site, it might be possible to compact the sand sufficiently to make piles unnecessary. Various ideas were explored, such as flooding, providing a temporary surcharge, and blasting to vibrate the sand. Then a process called vibroflotation was tried.

This process was tried at sites of previous drillings where soil densities had been measured. After the attempted compaction was completed, additional test holes were put down and new samples taken. The results were inconclusive. Densities were greatly increased in parts of the fill with a low clay content, but little improvement was noted where much clay was in evidence.

Since the only clay-free sand available was outside the planned dredging area and could not be economically obtained, it was finally decided that piles would have to be used. An investigation of the cost and suitability of various pile types led to the decision to use steel shells with cast-in-place concrete. Little waste would be involved as a result of indeterminate cutoff lengths resulting from the irregular bottom. The shells could readily be inspected after driving. Bearing capacities were adequate, and good shear strength could be developed by reinforcing the concrete core.

For each shed, 370 Raymond step-taper piles with 10-in. tips were used. They were required to be driven to a minimum depth of 40 ft or to a resistance of 35 tons, based on the ENR formula using a single-acting steam hammer with a 5,000-lb ram and a minimum energy of 15,000 ft-lb per blow. Piles were specified to be jetted through the fill and soft mud and driven a minimum of 10 ft into the original bay bottom. Actual driving resistances, based on the use of the formula, far exceeded the minimum requirement in all cases.

Concrete for piles contained 6½ sacks per cu yd and was vibrated in place. It was reinforced with four No. 6 bars running the full length of the pile and tied with a continuous taper spiral of No. 5 wire at a 6-in. pitch. It was thought desirable to develop as much column strength in the piles as practicable. Because of the layer of soft mud under the fill, it was considered possible that the fill in settling might exert a downward force on the piles. Some of the piles were required to sustain uplift in the event of an earthquake and it was essential that these contain longitudinal tensile steel.

Reinforced concrete pile caps were used for interior column foundations and for transverse walls where piles were placed in groups. Transverse walls were placed directly on the sand between pile caps and were designed to act as deep beams in spanning between support points.

There is a single row of piles along each side wall, one pile under each steel column, and groups of piles at the returns of the transverse walls where strong seismic loads must be sustained. A longitudinal grade beam, to act as a strut, connects the tops of the piles. This beam provides a seat for the side-wall panels as well as for the steel columns.

End walls, designed to resist seismic loads perpendicular to the planes of the walls, also sustain some vertical roof load. They exceed the h/d requirements for bearing walls, but since the roof load is a small fraction of the weight of the walls themselves, this was ignored and the walls were considered to be non-bearing. Pilasters were provided where carrying trusses frame in, and on each side of the center door, where the weight of the wall is carried to piles below.

Interior fire walls, made 12 in. thick to satisfy the underwriters, comply with the h/d requirements but otherwise are handled the same as the end walls. One special requirement of the Cotton Warehouse Inspection Service was that two buttresses be provided in the length of each fire wall. These are required to be 2 ft 6 in. in the direction of the wall and 6 ft perpendicular to the wall. They were placed half on each side of the walls and located under the carrying trusses. These buttresses are intended to sustain the wall against overturning in the event of a fire involving collapse of the roof.

Side-wall panels are designed as tilt-up slabs 20 ft long and 28 or 30 ft high depending on whether they are landside or waterside. Panels rest on the grade beam and are held against the steel columns by stud bolts welded to the columns. The bolts pass through the gaps between panels. Galvanized steel plates, extending the full height of the wall, are placed over the studs and bolted in place.

Plastic sealing compound, laid in ribbons along each edge of each plate, provides a weather seal at this joint. Panel tops are attached to the eave strut by clips designed to adjust to movement in the plane of the wall and also to resist movement perpendicular to the plane of the wall. This method of construction proved to be cheaper than the conventional method of using a cast-in-place concrete column between panels.

The general contract for the two transit sheds was $1,467,251.00 while the structural steel work, under a separate contract, required an additional expenditure of $419,260.00. Based on the area of 387,882 sq ft, this resulted in a total average unit price of $4.86 per sq ft. Structural steel was fabricated and erected by the Pacific Iron and Steel Corp. of Los Angeles. F. E. Young Construction Co. of San Diego was the general contractor on the buildings.

Design of the terminal, including basic design of the transit sheds, was carried out by the Harbor Engineering Division, with J. E. Liebmann, M. ASCE, Chief Engineer, under the jurisdiction of the San Diego Harbor Commission and John Bate, Port Director. Structural design was performed by Greer W. Ferver, M. ASCE, in association with the architectural and engineering firm of Freeland & Bird of San Diego.

Engineering research in the HIGH ARCTIC

FREDERICK F. IRVING, J.M. ASCE, Captain, Corps of Engineers, U.S. Army Engineer Arctic Task Force

For Undersnow Camp, a construction project 220 miles out on Greenland's ice-cap, trenches were excavated by Swiss "Peter" snow plow (near right), and roofed over using two types of wooden trusses covered with pliofilm and corrugated steel arches, as seen in other two views at top right. Ice-cap here is about two miles thick.

Some of the most unusual and extensive field research in engineering today is being carried out in northern Greenland by the U. S. Army Engineer Arctic Task Force. During the 1957 summer season, from May to September, no fewer than 22 different research projects were in operation, carried out by a team composed of the 298 men of the Engineer Arctic Task Force and approximately 150 civilian scientists and technicians from the Snow, Ice and Permafrost Research Establishment of the Corps of Engineers, from the Waterways Experiment Station, and from the Arctic Construction and Frost Effects Laboratory.

To understand the full importance of this research program in arctic engineering it is necessary to look for a moment at Greenland itself. Greenland is the earth's most northern land area of any appreciable size; it is about 1,600 miles long and approximately 650 miles wide at its broadest point. More than anything else it resembles a bowl of ice, with the coastal mountains forming a rim of land averaging about 15 miles in width. The ice in the center of the central plain is almost two miles thick. Temperatures in northern Greenland vary from +40 deg F in mid-summer on the land areas to as low as −70 deg F on the ice-cap in mid-winter. Wind velocities often reach 125 miles per hour in severe storms.

The mean annual precipitation is on the order of several feet of snow, and since in the central area loss is negligible, a load of millions of tons is added to the ice-cap each year. Pressures created by this additional load consolidate the underlying layers of snow and cause the ice thus created to flow slowly towards the edges. The rate of flow varies from approximately zero at the center to several feet per hour at some coastal glaciers.

On the west coast of Greenland, the U.S. Air Force has established Thule Air Base, which lies on the coastal strip of land some 700 miles above the Arctic Circle. The geographical advantages of this location to the defense of the North American continent are immediately obvious upon glancing at a map of the northern hemisphere. However, the problems of construction, transportation, and supply on the ice-cap itself have until now limited the use that can be made of the great ice-covered area of Greenland. Furthermore, construction could be considerably cheaper in arctic regions than heretofore if a way could be found to use natural materials—snow, ice and frozen ground—to the maximum. The Engineer Arctic Task Force and associated agencies have the purpose of solving some of the problems posed by construction in the high arctic.

The Task Force base, Camp Tuto, is a cluster of insulated canvas huts, called "Jamesways," located on the coastal gravel strip at the edge of the ice-cap 12 miles from Thule Air Base. This camp acts as a center for research projects carried out along the edge of the ice-cap and as a staging area for supplies and equipment to support projects conducted at any of the three camps maintained by the Task Force on the ice-cap itself. The quantity and variety of equipment maintained and operated out of Camp Tuto would do credit to a good sized construction firm. In addition to bulldozers, graders, and heavy trucks, there is a large quantity of specialized equipment that ranges from a Swiss "Peter" snow plow to delicate micrometeorological equipment to measure minute changes in wind and temperature at varying heights above the ground. All this equipment is needed to carry out the various research projects.

The Undersnow Camp

The Undersnow Camp is an example of one construction project on the ice-cap. The objective was to build a camp suitable for year-round occupancy and of simple and inexpensive design. Although constructed as a research project, this camp at Fistclench, 220 miles out on the ice-cap, is valuable for operational use. From it other research operations can be carried on.

Construction of the camp was begun by cutting a trench in the snow 8 ft deep and 20 ft wide using the Swiss "Peter" rotary snow plow. The trench was 600 ft long and was to house personnel and camp utilities when completed. Subsequent trenches were cut parallel to the first one for the maintenance of vehicles and to house generators, and all main trenches were connected together by smaller transverse trenches. The main trenches were then roofed over using two different types of wooden trusses and a corrugated steel arch roof for the maintenance trench. The wooden trusses were covered with 1-in. lumber and pliofilm used as a roofing material to seal out blowing snow. No support was used for the vertical snow walls of the trenches, and the trusses were merely supported on runners placed along the edges of the trenches. The purpose of these main roofs over the trenches was to take the snow load, which is approximately 3 ft per year.

Housing inside the trenches was of the Jamesway-hut type. These insulated canvas structures are entirely prefabricated and can be easily erected or taken down, but are not designed to take heavy snow loads.

All important structural features of the camp were instrumented and measured so that it would be possible to determine the shortcomings of the trusses and construction methods used. It is estimated that, after three years, snow accumulation over the camp will make it unsuitable. At that time, however, all the Jamesway huts and other important equipment and materials will be salvageable and can be moved to another location. The only loss will be the trench roofs themselves, which will eventually collapse under the weight of snow above them.

The Ice Tunnel

Another project with unusual construction features is the Ice Tunnel. This was begun in 1955 by going into the ice cliff near Camp Tuto using only picks and shovels. The first year prog-

Oil drums are placed on pile-supported platform for a load test on ice. Accurate surveys established amount and rate of settlement.

Ice tunnel has yielded valuable data to investigators. In an area where winds approach 125 miles an hour and temperatures drop to −60 deg F, tunnel is windless and has constant temperature of 14 deg F.

ress was only 500 ft, but in 1956 a narrow-gage mine railway was installed to carry out the ice, and in 1957 a standard-type coal-cutter was used to speed the mining, with complete success. The tunnel itself was extended to a length of 1,149 ft and two large experimental rooms were constructed approximately 30 ft by 100 ft in size. These rooms have been fully instrumented with gages to show the rate at which the roof and walls deform, a subject which has been little explored but which is of vital importance in planning practical uses for under-ice construction. Ice acts much like thick molasses when it is under pressure so that an excavation in the ice-cap slowly closes in on all sides.

The advantages of the Ice Tunnel for possible year-round living quarters are not immediately apparent and its constant temperature of 14 deg F seems unpleasantly cold to someone not acquainted with the area. However, during the Greenland winter, when temperatures drop to −60 deg F and winds approach 125 miles per hour, the windless 14-deg Ice Tunnel is a practical and desirable location. Insulated buildings to house personnel would need little structural strength and could provide maximum comfort at minimum cost.

Fuel stored in ice

The possibility of storing food in under-ice chambers has of course been known for a number of years. Over the winter of 1956-1957, however, the Engineer Arctic Task Force demonstrated the feasibility of storing fuel in the ice by placing aviation gasoline in two small pits inside the Ice Tunnel. No lining at all was used and the covers for the pits were merely a makeshift arrangement of lumber. Nevertheless, loss was negligible and tests on samples of the gasoline, though incomplete, indicate that it was in as good condition when removed as when it was placed in the ice. It is possible that it was in better condition when removed, since any moisture present in it would have

From two to three feet of gravel fill makes a satisfactory road on Greenland's ice cap. Natural ice ramps are impassable in summer because of severe melting and runoff.

frozen out on contact with the ice walls of the storage pit.

The structural potentialities of ice are in many ways similar to those of rock. However ice also acts as a plastic and flows very slowly under stress. This and other characteristics are all dependent upon the crystal structure of the ice, which varies depending on the pressure it is under and its method of formation.

Ice samples tested

The present experimental Ice Tunnel goes through no fewer than five types of ice in its 1,149 ft of length. A secondary project therefore is concerned with taking core and beam samples from the tunnel and testing them just as any other construction material might be tested. These samples must of course be classified as to their crystal structure and this, as well as other testing, is done in a small room, or "ice-lab," dug in one wall of the tunnel itself. Normal temperatures are thus maintained in the samples and their properties are prevented from changing while they are being tested.

The Approach Roads project

The Approach Roads project, begun in 1954, is an investigation of the methods and materials necessary to construct roads on ice. The main section is the Ramp Road which provides access to the ice-cap by way of the natural ice ramp near Camp Tuto. This is a project of practical as well as research value at the present time, since the ice ramp, without improvement, is impassable even to tracked vehicles during the summer months because of severe melt and resultant runoff streams. The road was added to in 1955 and 1956 until it is now three miles long.

Various materials and thicknesses were tried and it appears that from 2 to 3 ft of gravel fill on ice is satisfactory. This fill serves as an insulating blanket to keep the ice below from thawing. Difficulties occur at the edges, which slough off when melt occurs on the uncovered ice. The most practical approach found to this problem is to extend the slopes to form berms 50-ft wide along each side of the road.

Where the road crosses the melt streams at right angles a method must be found to carry the water under the road. Normal culverts soon become useless from undermining due to the melt of the ice. Half-round culverts work better since they allow the stream to erode its channel as the surrounding ice melts down. Additional research still remains to be done on this problem which, although it looks simple at first thought, is unusual and peculiar to ice-cap roads.

Other projects of the Corps of Engineers in Greenland include core drilling, snow compaction to improve techniques for building snow runways, electronic trail marking to enable tractor trains to operate under "white-out" conditions, vehicle performance tests, studies of explosives to develop reliable criteria governing their use in ice, and pile load tests to obtain data for designing pile-supported buildings on snow.

The unusual topography and severe climate of Greenland present many difficult engineering and military problems. The U.S. Army Engineer Arctic Task Force and all agencies participating in the Greenland research program are dedicated to conquering this last frontier and its engineering challenges.

For technical data and information on the research projects discussed above the writer wishes to acknowledge the assistance of the following agencies: Snow, Ice and Permafrost Research Establishment, U.S. Army Corps of Engineers, Wilmette, Ill.; Waterways Experiment Station, U.S. Army Corps of Engineers, Vicksburg, Miss.; and the Arctic Construction and Frost Effects Laboratory, New England Division, Corps of Engineers, Boston, Mass.

Where snow-melt streams occur, a half-round culvert has proved better than normal type, which is quickly undermined by melting ice.

THE REINFORCED CONCRETE RESEARCH COUNCIL

Past achievement and future promise in basic research

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Until his death on July 14, 1958, Mr. Blanks was Chairman of the Reinforced Concrete Council. This article has been prepared from the report on the Council by him and Dr. Hognestad, which appeared in the Proceedings of the American Railway Engineering Association, Vol. 59, 1958.

The need for a fundamental change in the theory underlying reinforced concrete design, to bring it into line with the actual inelastic properties of concrete and reinforcing steel, was recognized in this country shortly after World War II. And it was this need that was responsible for the birth of the Reinforced Concrete Research Council.

The classical theory of reinforced concrete design was developed some sixty years ago when reinforced concrete was a revolutionary, new material. The theory was based on the idealized elastic behavior of the component materials—concrete and steel. Though oversimplified, this theory of elastic working stress served us well indeed in the past, as is shown by the fact that the production of portland cement in the United States rose thirty-fold between 1900 to 1956—from about 10 million barrels to over 300 million barrels—as structural concrete grew from an engineer's toy to an important part of our technology.

Through half a century of practical experience and laboratory investigation, knowledge regarding the strength and behavior of concrete structures was vastly enlarged. To some extent, this progress was reflected in design practice by periodic adjustments and modifications of the elastic theory. Thus the original simplicity of the classical theory, based as it was a long time ago on a few fundamental assumptions, was largely lost. It became clear that the elastic theory was good enough in the past, but entirely inadequate for the future.

Then, in 1944, a subcommittee of the Committee on Masonry and Reinforced Concrete was formed in the Structural Division of the American Society of Civil Engineers. The subcommittee immediately commenced a study of the adequacy of the new inelastic design theories, and it became evident that a great deal of new experimental research was needed.

Such was the situation when the Reinforced Concrete Research Council was organized in 1948. Fundamental research in our universities had brought into being the nucleus of a new design theory known as ultimate strength design. To develop this theory to a stage of practical significance and usefulness, three things were needed: (1) an organized cooperative effort, (2) scientific planning and guidance, and (3) economic support of experimental investigations. In short, a hard push forward was required, a push that could not be accomplished by any single one of the interests involved.

The formation of a Research Council was approved by the Board of Directors of the American Society of Civil Engineers early in 1947, and the organization and financing of the Council was completed about a year later. the Council is an independent organization under the sponsorship of the Engineering Foundation. It consists of some two dozen representatives of technical societies, government agencies, trade associations, outstanding engineering organizations, and several universities.

The Council obtains funds from the Engineering Foundation and several interested organizations, so that each contributor receives many times the research value of his individual contribution. The total value of research sponsored by the Council is now approaching half a million dollars.

This research work is guided by the Council membership, all experts in their fields; and small task committees carefully follow each individual investigation or project. The actual project work has usually been done in universities, which through Council sponsorship not only get a laboratory job well done, but also make a most valuable contribution to our nation's future by training students to become the scientists and engineers of tomorrow. The results of projects sponsored by the Council have been published in technical journals and also in a series of ten bulletins available free from the Engineering Foundation, 29 West 39th St., New York 18, N. Y.

A milepost past

Organized in this manner, the Reinforced Concrete Research Council set out ten years ago to push past a milepost in the history of reinforced concrete design. The immediate broad objective was to reexamine critically the basis for reinforced concrete design methods, and to develop a new theory of design into a workable form intended to replace the elastic concepts that had been in use for many years. To reach this goal, many research projects were initiated, sponsored, and carried to a successful completion. We shall not dwell on the details of those projects here, but instead shall ask a question, "What were their final effects on engineering practice?"

In 1955, a Joint Committee on Ultimate Strength Design of the American Concrete Institute and the American Society of Civil Engineers submitted a final report completing its assignment "To evaluate and correlate theories and data bearing on ultimate-strength design procedures with a view to estab-

lishing them as accepted practice." These Joint Committee studies were based largely on experimental data and theories obtained through Reinforced Concrete Research Council sponsorship. The Building Code Committee of the American Concrete Institute then took a historic step, stated in one and one-half lines under Design Methods. This statement now appears in the 1956 ACI Building Code as "The ultimate strength method of design may be used for the design of reinforced concrete members." For ready reference, an abstract of the Joint Committee Report was appended to the Building Code.

Thus an entire family of improved design concepts were developed and made available for practical use. Better and more economical concrete structures have resulted, even when customary materials and construction methods are used.

Two promising trends

In addition, applications of ultimate-strength design have already led to two trends that hold great promise for the future. By its realistic and accurate appraisal of the structural performance of unusual concretes and reinforcing steels, ultimate-strength design has initiated a trend toward high-strength concretes and reinforcing steels. The American Society for Testing Materials is now in the process of revising reinforcing steel specifications. New steels with strengths about twice those now commonly used will probably be included in the new specifications. This development, and the companion trend toward high-strength concretes, are pointing toward the light, graceful, and economical concrete buildings and bridges of tomorrow. New projects sponsored by the Council are in progress to speed this development.

A second trend is related to the rapid growth of a new industry—the precast concrete industry. The potentialities of precasting go far beyond the mere concept of casting a member at ground level rather than several stories up in the air, or in a factory on a river bank instead of in mid-stream. These potentialities result in a large part from the advantages of mechanized mass-production methods that permit repeated use of forms and equipment, as well as the strict controls of manufacture necessary to use high-quality materials to the best economic advantage.

Careful design down to the smallest detail becomes of great importance when a member is to be made not once, but dozens and even hundreds of times —when a heavy investment goes into a mechanical manufacturing process. Therefore there is hardly any other way of designing for mass production than to use every trick available in the field of structural concrete technology. Only the best and most refined design procedures, such as those based on research brought about by the Council, are good enough to mass produce products that will effectively perform the function intended in the design, and at the same time be as economical as possible.

In this manner, the immediate broad objectives of the Reinforced Concrete Research Council were accomplished, and the Council turned to other tasks. Soon after the initial projects were started, it became evident that the Council offered an unusual opportunity to foster, correlate and sponsor other needed research in reinforced concrete. A Joint Committee on Shear and Diagonal Tension of the American Concrete Institute and the American Society of Civil Engineers was formed in 1950. A chain of research projects was planned, sponsored, and completed as a result of cooperation between this committee and the Council. This year the Joint Committee on Shear is preparing its final report completing its assignment, "To develop methods for designing reinforced concrete members to resist shear and diagonal tension consistent with the new ultimate strength design methods." Again an important report is being based largely on test data and theories developed through Council sponsorship.

Similar cooperation with technical committees led to projects directed toward improved design methods for reinforced concrete floor and bridge slabs. The Council is also sponsoring research in the fields of prestressed concrete, folded-plate structures, and several others. It has been found that the Council can also function to shorten the lag between research and practice by acting as a liaison agency between research agencies and technical committees of the American Railway Engineering Association, the American Society of Civil Engineers, the American Concrete Institute, and similar organizations. The scope of activities of the Council has accordingly been broadened to encompass the entire field of reinforced concrete research.

What of the future?

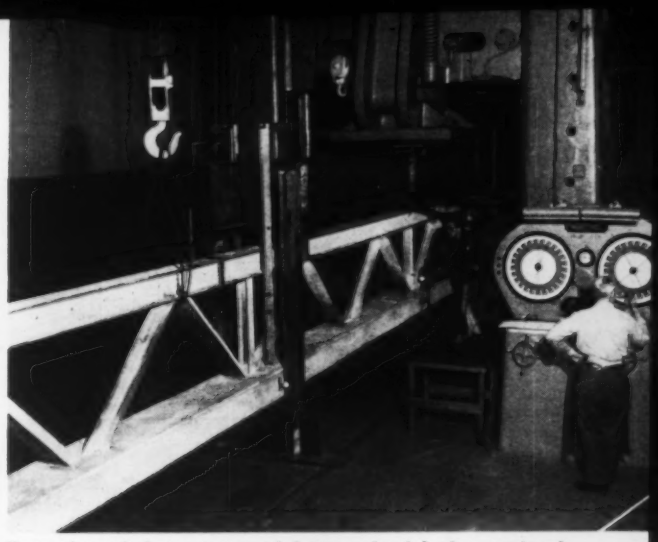
We have reviewed the past and present activities of the Reinforced Concrete Research Council. It seems fitting also to look at the future, though this can be done only on the basis of the personal views of the writers. Since the Council began to function ten years ago, research carried out by industry through trade associations has increased greatly. For example, the Association of American Railroads has constructed elaborate structural research facilities, and a large new Structural Laboratory was occupied last March at the Portland Cement Association Laboratories in the suburbs north of Chicago. Though this increased research activity was catalyzed to a considerable extent by the rewarding results of Council activity, it is fair to ask, "Does the Council have a future mission in spite of these changes on the research scene?"

To the writers the answer is emphatically "Yes." Research results are today being translated into practice at a rate without equal in the history of reinforced concrete. The chains of tradition have been broken, and most gratifying progress is being made toward better and more economical concrete structures. But this high-crested wave of activity rose out of several decades of basic research carried on slowly and on a small scale in our nation's universities, and the wave we see today must eventually die down. New waves in the future can evolve only from basic research, from investigations in our universities in which immediate practical needs are subordinated to long-range benefits.

This point can be illustrated by an imaginary situation. Let us assume that the finest practically inclined brains of the world were challenged over a hundred years ago to do everything possible, regardless of cost, to improve artificial light. What activities would have resulted? Elaborate studies of gases and fuels, of pumps, fixtures and burners, of shades, lenses and mirrors, would have been initiated. But it took the penetrative curiosity of a basic scientist to follow a radically different and immeasurably more fruitful path. It took the quiet genius of Michael Faraday to discover the principle of electromagnetic induction, a discovery that not only led to improved light but became the basis of an entirely new technology.

The initial objective of the Reinforced Concrete Research Council was to improve the elastic theory of reinforced concrete design. This activity was later broadened to encompass the entire field of reinforced concrete research. It is today a policy of the Council, in selecting proposals for sponsorship, to give preference to those projects which are most likely to result in useful information of immediate practical value to the engineering profession. Much research so directed remains to be done. The writers believe, however, that the greatest mission of the Reinforced Concrete Research Council of the future may well be to foster, sponsor, and correlate fundamental work in our universities, work directed toward provoking the radically new ideas destined to color our tomorrow and the future beyond.

Composite truss of new type



Tests showed that prestressed bottom chord had a torsional resistance unknown to ordinary reinforced concrete. Thus bottom lateral system is not needed in truss of this type.

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Anyone dealing with prestressed concrete speedily becomes aware of two facts: first, it is very heavy, and second, if beams or other relatively narrow, deep members overturn or in any other way become unbalanced, they tear themselves to pieces. An excellent demonstration of this fact is to be had by setting a normal, bottom-stressed beam down on a single, central support.

A certain dissatisfaction with these qualities of prestressed concrete led the writer to consider possible ways of improving it. The search was undertaken somewhat in the spirit of Bairnsfather's cartoon of First World War days in which two seasoned British veterans, caught in a shallow shell hole during heavy bombardment, argue heatedly until one puts an end to further words by saying, "If you know a better 'ole, go to it!"

Naturally enough, "better 'oles" are not readily found and when found are not without their shortcomings. However, a structural shape with certain marked advantages was finally found in the form of a composite steel and prestressed-concrete truss. Its bottom chord is a rectangle of prestressed concrete but its webs and top chord are of structural steel. A very great reduction in weight is effected by this combination, while steel's adaptability to both compressive and tensile stresses terminates all instability hazards. For transportation and erection there is an unquestioned improvement. On the other hand, steel's need for occasional painting is unaltered, and fabrication costs persist.

The pretensioning and post-tensioning alternatives that apply to prestressed concrete are equally applicable with composite construction. Pretensioning makes it possible to have the concrete chord cast and stressed in one place, the steel fabricated in a second place, and the two combined in a third place, if desired. If the concrete chord is made separately, steel connectors of some sort must be embedded and anchored in the concrete at the panel points with which the web members can be united. Separate chord tensioning, pre- or post-, produces a very clean and simple stress pattern in the truss—zero stress in the top chord, zero stress in the web members, and the applied axial compressive stress in the bottom chord, which of course is the tensile stress that has been jacked into the prestressing strand.

Where complete fabrication of steel is wanted in one operation, including anchorages and connectors, and where pretensioning facilities are not available, post-tensioning is the logical, not to say only, alternative. It will be necessary to provide as much of a small steel bottom chord as is needed for shop handling of the steel and its transportation to the casting yard. There it will have to be set up and maintained in position until the concreting and tensioning have been completed. Then it is ready for service.

With post-tensioning, the webs and top chord are deformed by the shortening of the bottom chord but, being of steel, they are none the worse for it, particularly since the imposed deformations are contrary to those to be developed by subsequent loading.

The potentialities of this form of construction in the range of spans beyond those covered by wide-flange beams led the Northwest Steel Fabricators Association to investigate its performance by building a specimen 70 ft

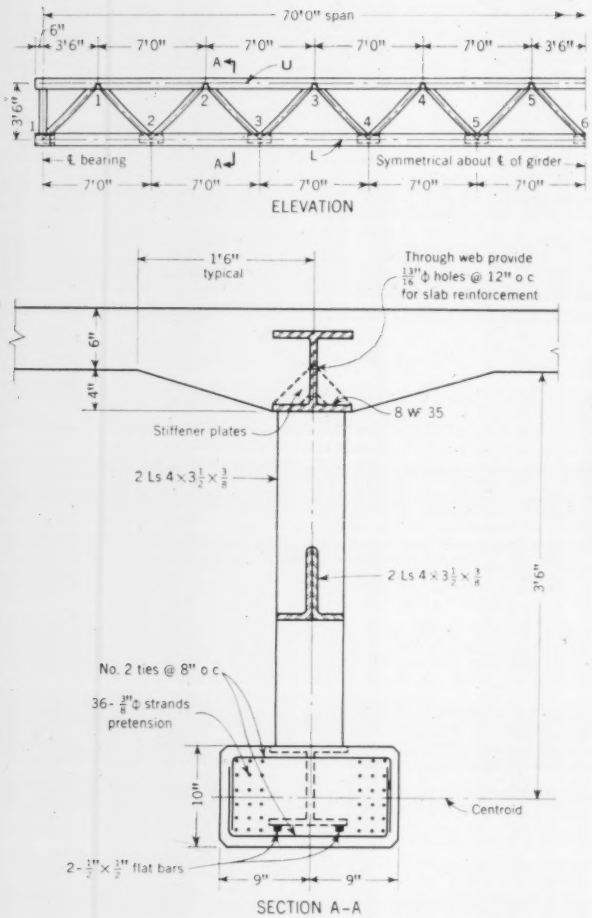


FIG. 1. In composite truss, bottom chord is rectangle of prestressed concrete while webs and top chord are of structural steel.

long and having it tested at the Engineering Experiment Station of the University of Washington, under the direction of Prof. F. B. Farquharson, M. ASCE. Details of this experimental truss are shown in Fig. 1. The prestressed-concrete bottom chord is 18 in. wide and 10 in. deep. The top chord is an 8 WF 35. The webs are angles $4 \times 3\frac{1}{2}$ and $5 \times 3\frac{1}{2}$, of varying thickness. The chords are 42 in. on centers. The 70-ft length is divided into ten 7-ft panels. Flat bars were used as spacers and also for shop handling purposes.

For this single truss the simplest arrangement was to have the concrete chord pretensioned by the Concrete Technology Corporation of Tacoma. Arrangements to that end were therefore made. The wide-flange sections for embedment in the concrete were shipped to Tacoma, and the chord was fabricated there and in due season shipped back to Seattle, where the steel of webs and top chord was welded to it. Shortly thereafter the truss was transported to the University.

In the writer's mind there were only two uncertainties regarding the behavior of this composite truss for practical use:

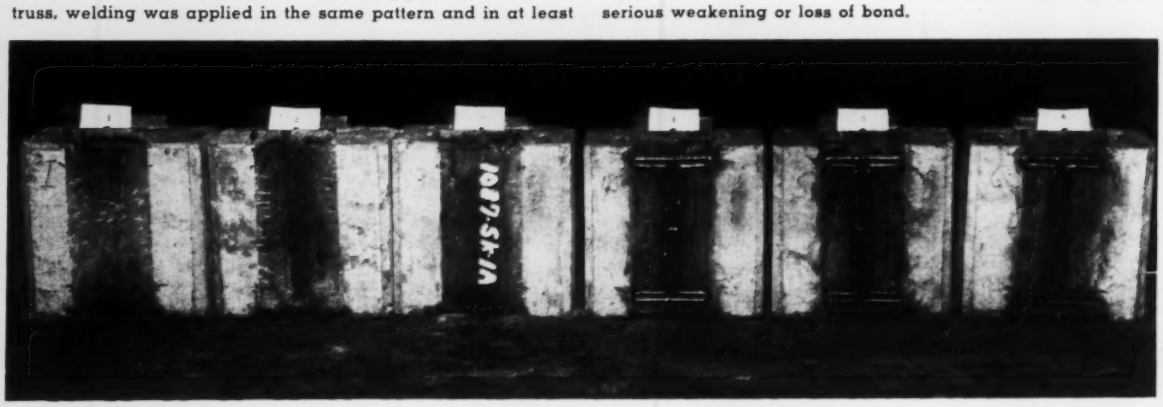
1. Would the top chord, the 8 WF 35, possess adequate lateral stability to withstand rough treatment in handling and erection on a 70-ft span? After all, 8 in. of width in a length of 840 in. is not a large percentage.

2. Would the heat of welding the web angles to the embedded wide-flange sections seriously injure the adjoining concrete and destroy its bond?

Probably the most significant fact to emerge from the testing of this truss is that the concrete bottom chord, subjected to the pressures of all the tautly stretched prestressing strands, possesses a torsional resistance unknown to the common, reinforced variety of concrete. Since transverse rotation can only be accomplished by further stretching and lengthening of each individual prestressing strand, the resistance to rotation is vigorous and pronounced.

In this truss the web members, once they had been welded to the bottom chord, became practically fixed at all the connecting points and everywhere acted to hold the top chord in position. No similar restraint develops from the bottom chord in an all-steel truss nor does such a truss show any corresponding resistance to lateral bowing and displacement. Assuredly there is no need for a bottom lateral system with composite trusses of this type. The virtues of prestressed concrete are largely concentrated in the zone of its prestressing

On three of six small specimens, simulating panel points in the truss, welding was applied in the same pattern and in at least equal amount. Tests showed that the heat of welding caused no serious weakening or loss of bond.



steel and their full potentialities are realized in the straight bottom chord of the composite truss.

The other fact shown by the test is that the heat of welding the web members to the embedded steel sections causes no serious weakening or loss of bond. No cracking, chipping or other evidences of trouble were observed, nor did the needle on the testing machine give any indication of slippage.

A more convincing demonstration of the significance of such heating came from the supplementary testing of six small specimens simulating the panel points in the truss. Connector sections of 8 WF, each 19 in. long, were embedded, flush on one side, in concrete prisms 10 in. × 18 in. and 18 ½ in. long. At one end, the end of the wide-flange section projected one inch beyond the end of the concrete prism; at the opposite end the concrete overlapped the steel by ½ in. but was prevented by wood strips from getting under the steel. As shown in a photograph, on three of the specimens welding was applied in the same pattern and to an extent at least equal to that used in welding the web members to the bottom chord of the truss.

Here the concrete was subjected to a punishment which actually was more severe than that taken by the truss since there was no dissipation of heat into the steel of the web members. Twenty-seven days after the specimens were made, they were tested by being loaded axially, the head of a 300,000-lb testing machine being brought down on the projecting end of the steel while the concrete end bore on the bed of the machine. In all cases the use of leveling shims was necessary, the cut surface of the steel not being truly parallel to the bearing surface of the concrete but apparently being slightly higher at one corner. Loading revealed only minute differences, the loads sustained by each of these specimens being over 290,000 lb. Furthermore there was the possibility that these observed yieldings of the specimens may have been at the high points of the steel rather than a matter of bond with the concrete. The ready-mix concrete for these specimens contained 6.35 sacks of cement per cu yd, and tested to 5,375 psi at seven days. From these tests it was concluded that steel embedded in concrete can safely be welded.

As for the truss, the bottom chord of which had been subjected to 360,000 lb of pretensioning it was loaded on its 70-ft span at panel points 10½ ft each side of the center line. It was designed as one of four such trusses that would carry a 70-ft highway span with a two-lane concrete roadway and H20 S16 loading. The most severe loading condition in the top chord of the truss develops when, after erection and with forms in place, the top chord is subjected to the weight of the freshly placed concrete.

After the concrete has set and hardened so that all but the under surface of the top chord is embedded, no further weakness exists. But before the development of this condition the top flange is the weak element of the combination, since webs and bottom chord are designed for both dead and live load whereas the top chord is designed for dead load only. No concrete was applied to the test truss.

Two panel-point loads totaling 30,000 lb produced compression in the top chord equal to that which the assumed roadway slab would have induced. Loads were progressively increased, and at a total load of 77,400 lb the top-chord stress was slightly over 30,000 psi. As the load rose from 65,000 to 77,400 lb, numerous Luder lines appeared on the web and flanges of the top chord. Maximum deflection was 2.34 in., and residual deflection on removal of load, 0.23 in. In a nine-day cylinder test, the bottom-chord concrete took 8,631 psi.

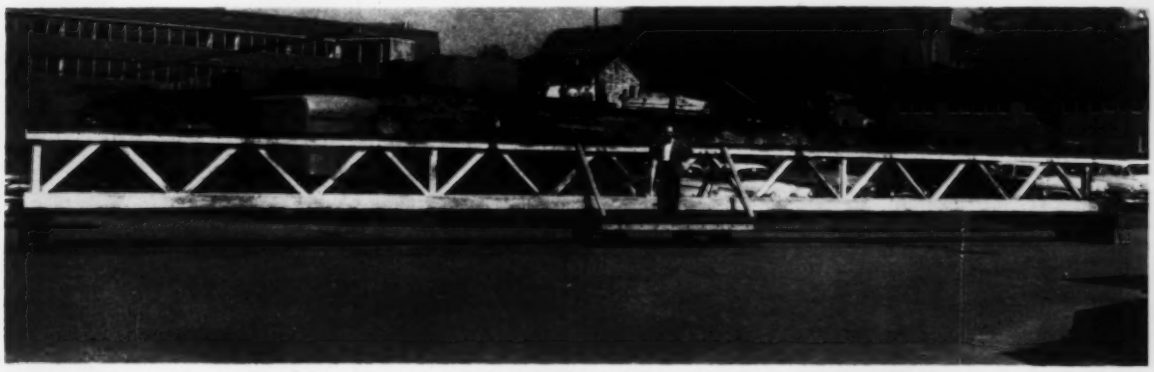
The only conclusion to be drawn from this truss and its test loading is that prestressing of composite members is an entirely simple, practical method which has certain marked advantages compared with either all-prestressed concrete or all-steel construction. Particularly as spans lengthen, the reduction in weight below that of all-prestressed construction becomes pronounced.

No position of the composite truss, whether pretensioned or post-tensioned, entails disastrous consequences. It can be shipped flat on its side should that be desirable, and it can be picked up at the quarter points or even closer to midspan without dangerous overstress. Because of its light weight and good handling qualities, one erection crane can replace the two that would be required with heavier prestressed members. It eliminates the bottom lateral system required with all-steel trusses and is much more resistant to transverse rotation than the all-steel truss. Its light weight may well result in lessening the number of required foundation piles and in reducing the size of footings.

The development and use of this type of truss is a matter of economics. There is nothing final about the arrangement or dimensions of parts used in this particular test truss, and improvements undoubtedly can be made in it. Its cost appears to be quite competitive with that of all-prestressed concrete in many cases and therefore it undoubtedly is of more than passing interest.

This truss was built and financed by the Pacific Northwest Steel Fabricators Association. Concrete Technology Corp. of Tacoma performed its part of the work at a very helpful price, for which thanks are due them. The design was prepared by the writer.

Composite truss is 3 ft 6 in. deep center to center of chords and 70 ft long. Standing beside the truss is Prof. F. B. Farquharson, M.ASCE, head of the Engineering Experiment Station, University of Washington.



$10 million adds 200 mgd to Detroit water

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REMIG A. PAPP, M. ASCE, Senior Engineer, Hazen & Sawyer, New York, N. Y.

Fig. 1. Detroit's water-treatment expansion program includes a booster station on raw-water tunnel at Waterworks Park and 200-mgd addition to Springwells Station, described in this article.

In the midst of investigations and much activity in regard to metropolitan Detroit's future sources of water supply, the Detroit Water Board has proceeded with the construction of distribution and treatment facilities needed immediately to augment the present works. These include a booster station on the raw-water tunnel at Water Works Park, and a 200-mgd addition to the Springwells Station. See Fig. 1. The Springwells expansion consists of the installation of larger pumps in the existing low-lift and high-lift pumping stations and the construction of additional purification-plant capacity. An additional filtered-water reservoir is to be built later.

Construction of the new facilities has been under way at Springwells for the past two years, and they are expected to be in operation by the summer of 1959. This article deals with the purification plant and appurtenances.

The Springwells plant, built between 1929 and 1933, is one of three filter plants serving the city. When it was built, no provision was made for increased capacity since it was anticipated that additional facilities would be built elsewhere in the city. Expanding the plant from 340- to 540-mgd capacity has required unusual planning of construction and called for many design studies to determine the most economical layout for connecting the new facilities with the old.

When the design was begun, it was planned to expand to the west by acquiring sufficient land in a residential area for the construction of filters and double-deck basins. An alternate scheme was suggested which required land to the north, sufficient for con-

TABLE I. Springwells filter-plant expansion, design elements

Design capacity 200 mgd, hydraulic capacity 250 mgd

No.	Structure	Dimensions	Capacity and Design Loading at 200 mgd
2	Rapid mixing chambers	13′ X 13′ 20′ deep	Mixing time, 22 sec
4	Flocculating basins	94′ 8″ X 95′ 0″ 18′ 3″ deep	Flocculating time, 35 min
4	Sedimentation basins	490′ X 100′ 16′ 0″ deep	Settling time 2.8 hr; surface loading, 1,040 gal per sq ft per day
40	Filter beds, 43,320 sq ft	19′ X 57′=1,083 sq ft each	Filter rate 3.2 gal per sq ft per min
3	Wash-water pumps	26,000 gpm each	Variable speed capacity from 8,000 to 26,000 gpm
3	Waste wash-water pumps	Two, 12,000 gpm, one, 6,000 gpm	.....

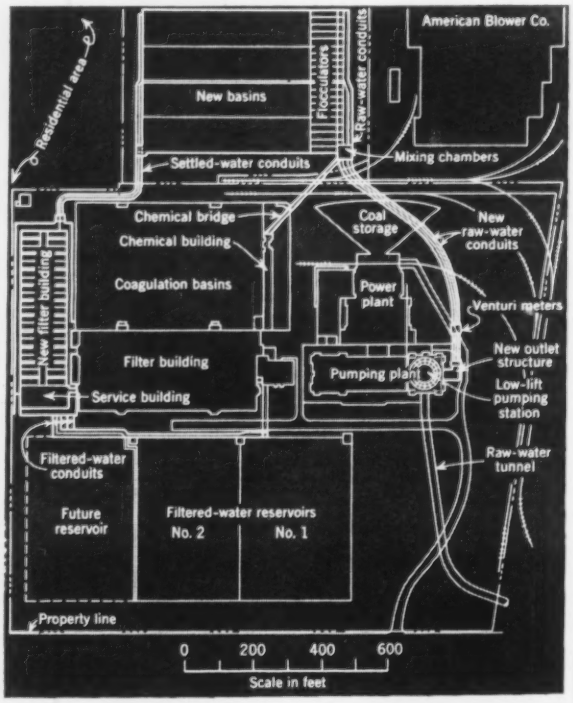


Fig. 2. Expansion of Springwells water treatment plant includes new sedimentation basins and flocculators on land newly acquired to north of existing plant.

treatment plant

Excavation for filtered-water conduit goes down through plastic blue clay, which extends to depths of 90 to 110 ft, where hardpan is encountered. New facilities have been built on the clay without piles, except for outlet structure and raw-water conduits.

struction of single-level basins, leaving city-owned land for the filters. The second solution meant fairly long conduits to and from the new basins and placed the mixers and flocculators some distance from the operating area of the existing plant (Fig. 2). However, the second plan was adopted, because the land was undeveloped and could be acquired as one parcel without lengthy condemnation proceedings, and because it eliminated the need for deep foundations immediately adjacent to the existing basins and filter building.

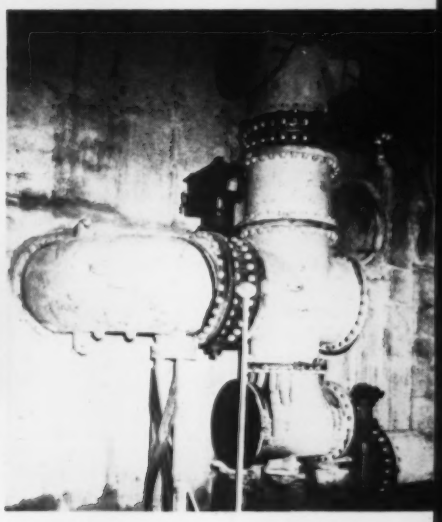
Dimensions and ratings of the principal elements of the new works are summarized in Table I.

From the low-lift pumping station, the raw water will flow through two Simplex 96-in. × 53.59-in. Venturi meters and connecting conduits to rapid mixers at the southeast corner of the new basins.

Liquid alum, carbon slurry and chlorine may be fed to the mixers from the existing chemical building, through chemical lines carried on an overhead access bridge.

The rapid mixers, from the Mixing Equipment Co., are of the vertical turbine type, designed to operate between 25 and 100 rpm. Each flocculating basin is divided longitudinally into five parallel-flow sections, each with conventional Jeffrey paddle-wheel flocculators in four compartments mounted on a horizontal shaft parallel to the line of flow. (See Fig. 3.) Each shaft is equipped with an independent driving unit consisting of an electric motor, a fluid torque-limiting speed variator, gear reducer and chain drive. The flocculator drives are readily accessible in an open gallery directly over the raw-water conduits. Flow of water to the basins is controlled by valved inlet ports. A perforated baffle wall between the flocculating chambers and the settling compartments provides distribution within each basin. The existing plant has a low-velocity, baffled mixing chamber.

Flocculator-drive gallery runs along east side of building. See Fig. 2.



Piping for one double filter bed includes power-actuated Pratt valves of 30-in. diameter on wash-water and drainage piping.

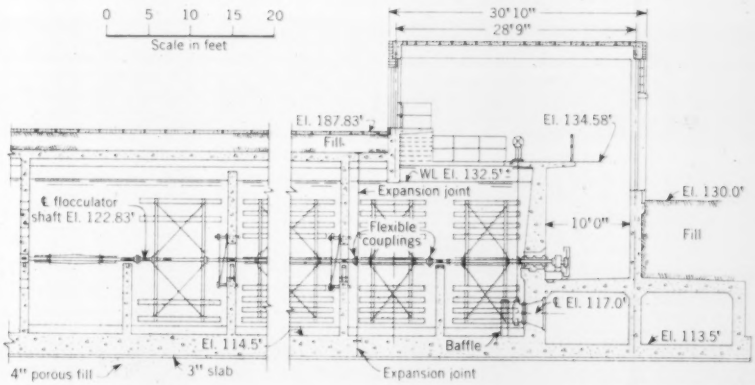


FIG. 3. Section through new flocculators shows arrangement of basins about 95 ft long and 18 ft deep. Flocculating time is 35 min.

Use of precast-concrete for wash-water troughs (above) represents a considerable saving as compared with other durable materials. Roof of new filter building (above, right) consists of three thin-shell barrels on each side of north-south gallery. Shells have a chord of 19 ft 5 in., span of 44 ft, and total length of about 444 ft in three sections.

The 16-ft depth of the sedimentation basins is shallow for structures of this size, and compares with a depth of 18 ft 6 in. in the old Springwells Plant, and 19 ft in the newer Northeast plant. The basins are covered by a concrete slab resting on columns 18 ft × 21 ft on centers, and topped by a 22-in. layer of earth for insulation. For semi-annual cleaning the basins will be taken out of service one at a time.

Settled water flows to the filters through two parallel box conduits, each 7.5 ft × 10.5 ft. Preliminary laboratory tests indicate that the new facilities will yield clearer water than the existing plant. Therefore a connection is provided so that water from the new basins can flow to both the new and the old filters, in order that the new basins may be used to reduce the load on, and thus improve the effluent from, the existing basins.

Forty new filters

The 40 new filters are arranged on both sides of a north-south filter gallery (Figs. 2 and 4). The settled-water conduits extend along the sides of the filter building and feed the filters from the outside rather than from the filter gallery. The filtered-water headers consist of concrete box conduits, placed under the inboard end of the filter beds. The wash-water drain is carried underneath the filter-pipe gallery. The effluent rate controllers, the wash-water supply, the surface wash-water, the heating piping, and the necessary operating valves are ranged along the two side walls of the gallery, leaving the middle open for ready access. This arrangement, combined with a "drive-in" ramp at the north end of the building, enables small trucks, forklifts, and other equipment to travel the length of the pipe gallery. This layout has been of great help in the installation of the large pipe and fittings, and will ease maintenance work in the future.

Filter beds are operated in pairs, each double filter having an area of about 1/20th acre. A single influent valve, rate controller, wash-water gullet and wash-water drain serve each double filter, but only one side of the filter is washed at a time. The relatively narrow width of the filter bed yields maximum economy in construction cost, and permits the use of light precast-concrete wash-water troughs at a considerable saving over other durable materials.

Each filter bed will be equipped with twelve rotating surface sweeps of 9-ft diameter. Nineteen of the filters will have glazed-tile perforated underdrain blocks, 12 in. of graded gravel and 20 in. of sand, while the twentieth filter is equipped with a precast concrete bottom. Fairly coarse sand with an effective size of 0.52 to 0.58 mm has been specified.

The service building at the south end of the filters contains a filtered-water well and discharge weir, a waste-water well, and the wash-water and drainage pumps. The two wells are separated by an air space to eliminate the possibility of contaminating the filtered water.

In the original Springwells plant, a filtered-water "shunt system" normally discharges the water directly from the filters to the high-lift pumps, bypassing the clear well. The clear well is utilized only at periods of peak demand, and the high-lift pumping head under normal conditions is thus reduced considerably. The shunt system has been extended to the new plant. Water will flow through box conduits to the existing shunt connection and the filtered-water storage reservoir. The design of a new weir system and its connections to assure proper and self-regulating coordination of the new and old plant was based on extended hydraulic measurements and calculations.

The wash-water supply is taken from the filtered water well. Variable-speed pumps, driven by wound-rotor motors operated by automatic program control, will be used to wash the old filters as well as the new units. The existing wash-water tanks near the roof of the old filter building will be taken out of service and kept for emergency use only. Heretofore it has been necessary to throttle the wash valve at each of the old filters to control wash rates, and valve wear has been a maintenance problem. In addition, the pumps that refilled the tanks took their suction from one of the effluent headers and the resulting pressure changes disrupted the operation of the shunt storage system.

Waste wash-water is discharged into a combined sewer on Diversey Avenue, just west of the plant. During heavy storms, the sewer is surcharged and gravity flow from the filters to the sewer is impossible. To discharge waste wash-water to the sewer during such times, waste-water pumps were installed in the service building. Also, the waste wash-water can be pumped back to the rapid mixing chambers if it becomes desirable to conserve it or to recycle floc.

The Springwells site is underlain by plastic blue clay to a depth of 90 to 110 ft, where hardpan is encountered. The original plant was founded entirely on timber piles, of which 1½ million lin ft were driven for the purpose. Accurate records of settlement have not been kept, but surveys indicate that the structures are within 2 in. of their original elevations. There has been no movement of the low-lift pumping station, a deep caisson founded on the hardpan.

Since the low-lift caisson was circular, and the superstructure above it rectangular, a number of piles and small-diameter caissons were placed around the periphery of the main caisson to support the building wall. The small caissons and piles were a considerable obstacle to threading the new raw-water conduits into the low-lift pumping station.

Except for the outlet structure between the low-lift pumping station and the raw-water conduits, the new facili-

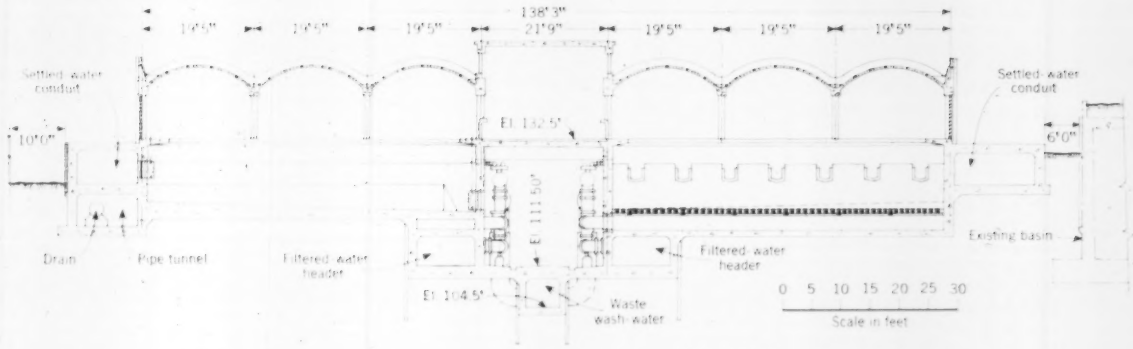


FIG. 4. Cross section through new filter building shows left side through gullet, right side through manifold. Forty filters are arranged on both sides of the gallery.

ties have been built without piles. The original caisson installation had so disturbed and weakened the surrounding clay that piles were considered necessary for the outlet structure, which is supported on 49 predrilled steel-shell concrete piles to hardpan. Six battered piles take the horizontal thrust in the raw-water conduits. In addition, flexible joints are provided between the outlet structure and the existing building, and between the outlet structure and the raw-water conduits.

Elsewhere throughout the plant, excavations were kept relatively shallow, and loads were distributed over wide areas by mat foundations. Unit loadings were kept below 1.25 tons per ft under the sedimentation basins and filter building, and less than 1.75 tons per sq ft under the deeper service building. Particular care was taken to avoid sudden changes in the unit loadings from one area to another. In this way, settlement is expected to be slight and relatively uniform throughout the structures.

The deepest excavation was for the filtered-water and wash-water wells under the service building, where a depth of nearly 30 ft below the ground surface was reached. Part of the foundation was enclosed with permanent steel sheetpiling to prevent movement of the adjacent old and new filter buildings. It was necessary to excavate for and construct the deeper parts of the structure in sections to prevent a mass movement and upheaval of the plastic clay.

To decrease uplift pressures, the basins and filters are underlain with layers of sand and gravel from 4 to 12 in. thick, feeding a drainage system of perforated tile pipe.

Concrete construction

About 82,000 cu yd of reinforced concrete will be required for the completed plant. Most of the concrete was placed in fairly heavy sections for the basins, filters, and service building. The roof of the filter building consists of a number of thin-shell barrel arches.

A double center wall divides the new sedimentation basins into two independent structures, each 636 ft long by 206 ft wide, including the flocculator gallery at the end. Expansion joints were placed across the bottom slab, walls and roof slab at approximately 100-ft intervals. The floor and wall joints are ½ to 1 in. wide with 9-in. rubber water stops of dumbbell shape. The joint space was created by Flexcell and sealed with a two-component rubber joint sealer with Thiokol base. The rubber water stops were omitted in the roof joints.

In addition to the expansion joints, "shrinkage strips" were placed in both directions at 60- to 70-ft intervals. The shrinkage strips, 3 ft wide, were poured weeks after the adjacent slabs, at a time when the temperature was low, to take advantage of all possible contraction. The delayed placing of concrete in narrow strips is considered much better than placing it in checkerboard fashion because the shrinkage within a single wide pour may be substantial. Steel plates 6 in. wide were placed in all ordinary construction joints to serve as waterstops.

In the filter building the same type of construction was used. One expansion joint separates the service building from the filters and two additional expansion joints divide the filter building into three parts. In addition, intermediate shrinkage strips were used.

The roof of the sedimentation basin is of flat-slab construction. The flocculator-drive gallery has a reinforced-concrete frame, with a 4-in. reinforced-concrete roof slab. The filter gallery roof is of concrete beam-and-slab construction. On each side of the gallery the roof over the filter beds consists of three thin-shell concrete arches, with the barrels running the length of the building (Fig. 4). The arches rest on columns mounted on the division walls between filters and have a 19-ft 5-in. chord and an unsupported length of 44 ft. The roof over each bank of filters is poured in three sections, two end sections 132 ft long and one middle section 176 ft long. Use of short-chord arches avoids concentrated loads and at the same time provides a smooth ceiling, easy to form and construct, and easy to keep clean and maintain.

The service building has a steel-frame superstructure with gray limestone facing, designed to match the existing Springwells buildings.

Construction schedule and cost

General excavation for the basins and filter building was carried out under a contract let in October 1956 to Charles J. Rogers, Inc., at a cost of $238,595. This work was completed by January 1957. Bids for the general contract were opened on April 30, 1957, and the successful contractor was the O. W. Burke Company of Detroit with a bid of $9,796,000. The contract calls for the completion of the water treatment plant by June 1, 1959. Excellent progress has been made, and it is expected that the schedule will be met. O. G. Sharrar is general superintendent, M. L. Shaffer and L. F. Tulk, J.M.ASCE, are project engineers for the Burke Company. The Geo. A. Bass Construction Company is installing mechanical equipment for the O. W. Burke Company.

Expansion of the Springwells Station by the Detroit Water Board is under the direction of Gerald Remus, Superintendent, General Manager and Chief Engineer, and A. C. Michael, A.M.ASCE, Assistant Chief Engineer. Additions to the purification plant were planned and designed by Hazen and Sawyer, engineers, and C. L. T. Gabler and Associates, architects. Consultant on foundations was Prof. William Housel, M.ASCE, of the University of Michigan. Supervision of construction is under the direction of the Detroit Water Board with G. Olson in charge at the site.

OPPORTUNITIES in the CEC for

Many of today's engineering students are undecided as to what they would like to do after graduation. Not only does the engineering field open many paths but the administrative or management field is also beckoning, and the present draft laws constantly remind them of their military obligations. To many such graduates, engineers and architects, the Civil Engineer Corps of the Navy (CEC) offers an opportunity to fulfill these military obligations as an officer while gaining experience in both engineering and administration. This organization is responsible for the design of military facilities, the performance and administration of new construction work, and the maintenance and operation of all naval shore facilities.

Many large industrial companies consider the experience gained in the Civil Engineer Corps equivalent, if not superior, to that gained in private industry during the three years immediately following graduation. They strongly recommend seeking a commission in the Corps for three years instead of being drafted for two years. The professional development, responsibility, pay, and privileges received as a commissioned officer with a military engineering group are well worth the additional year of obligated service.

Engineering for the Navy

Within the vast Navy organization, a small tightly knit group of 1,500 CEC officers perform engineering services for the Navy. There is little room for the specialist. The individual must be prepared to widen his horizon to cover all phases of engineering and management and in many cases he must accept a large amount of responsibility. At present, the CEC has an unbalanced distribution in rank of its officers. There is an overabundance of Ensigns and Lieutenant j.g.'s and a deficiency in the ranks of Lieutenant and Lieutenant Commander. As a result many young officers are holding billets that in the past have been filled by more experienced older officers. Thus there are many good opportunities for interesting and responsible positions in the CEC.

A new CEC officer may be assigned to any one of four basic types of duty:

1. District Public Works (DPW)
2. Resident Officer in Charge of Construction (ROICC)
3. Activity Public Works (PW)
4. Construction Battalion (CB)

These billets combine engineering and administrative work and require an engineer's training. In many cases the ability developed to deal with people is more valuable than dexterity with the slide rule.

District Public Works

In each Naval District there is a District Public Works Office (DPWO) which supplies technical assistance to the local Public Works Department at each naval activity in the district. An ensign may be assigned as assistant to the CEC officer in charge of an operating division in design, construction, or maintenance or as an assistant to the Project Management Officer. In each division, the military assistant's billet is entirely administrative, with no specific duties or set format. The scope of the position will depend on the division officer and the immediate requirements, but usually will involve correspondence, increasing division efficiency, and inter-division communications.

In the Project Management group, the junior officer serves as a liaison officer between the naval activities within the district and the DPWO operating divisions. DPW officer billets involve little design work but provide excellent administrative training.

The District Public Works Officer is also the Officer in Charge of Construction (OICC) for the district. In this capacity he administers all new naval construction being done by contract. The OICC organization consists of the District Public Works personnel and the Resident Officer in Charge of Construction (ROICC) and his staff. The ROICC represents the Navy at the construction site and inspects and administers the contract with his staff of CEC officers and experienced civilian inspectors. Most such construction work is performed under contract, awarded to the lowest competent bidder. The ROICC staff may administer jobs varying widely in size and scope: a $250,000 dredging job at a shipyard, a $10,000,000 alteration on a drydock, or perhaps a $30,000 building.

Finalizing plans and specifications, advertising for and receiving bids, and awarding contracts—all are performed by the DPWO. Upon award of the contract the ROICC supplies the contractor with all the information he needs and assigns civilian inspectors to the job. Administrative work includes daily reports, progress schedules, checking of payrolls and payment request, keeping the DPWO informed of contract progress, and final acceptance of the work. The assistant ROICC billet necessarily requires paper work, but also carries with it responsibility and requires decisions. Being actually at the job site, the CEC officer can learn much about the various types of construction.

Public Works Office

At each naval shore activity, save a few, there is a Public Works Officer responsible for maintenance and operation. Through its Public Works Departments the Navy spends $600 million yearly to maintain its $14-billion shore facilities in a constant state of readiness—in comparison to the $400 million spent for new construction.

A new officer in the Public Works Department may become Assistant Public Works Officer (APWO) at a small station, or Maintenance Officer, Utility Officer, or Transportation Officer at a large station. All four are positions of authority and require the ability to deal with older and more experienced civilian personnel.

The "Golden Boys" of the CEC are those who lead the Construction Battalions (CB), more commonly known as the Seabees. These fighting construction men with their "can do" motto won the respect of all fighting men during World War II. Their main mission during that period was the rapid

graduate engineers

— PETER del VALLE, Jr., J.M.ASCE, LTJG, CEC, USNR

construction and operation of advance bases. In peacetime the Seabees gain experience through construction, mostly overseas, on facilities that require strict security or where it is impractical or uneconomical to employ civilians. Today they are found in Morocco, Spain, the Caribbean, Alaska, Newfoundland, the Philippines, many islands of the Pacific, and even at the South Pole. During World War II the Seabee battalions were made up of experienced construction workers, averaging well over 30 years of age. Today, a battalion has less experienced men, in their early 20's, but it still lives up to the "can do" reputation for which it is so justly famous.

Seabees usually overseas

Since Seabees are overseas three-fourths of the time, the duty is undesirable for many married officers because their families cannot accompany them. However, this is an exceptionally desirable duty for the young engineer interested in construction work, traveling to out-of-the-way places, and commanding men.

The CEC officer's tour of duty may take him anywhere in the free world. Many reserve officers receive two equal tours of duty during a three-year period of active duty, one overseas and one stateside. In other cases, duty at one location may last most of three years. In the States, billets are available in all sections of the country. With few exceptions, regardless of where he goes, the married officer can take his family and furniture with him at government expense. At his new assignment he will find others willing and ready to make him feel at home. There are few groups in the armed services small enough to take such an active and personal interest in each and every one of its members as the Civil Engineer Corps of the Navy.

The first step towards obtaining a commission in the CEC is a visit to the nearest naval recruiting office, about five months in advance of the date when the applicant will be available. At the recruiting office there are mental and physical examinations, interviews, forms, and a generous amount of waiting.

The applicant must then wait about four months while his application is processed and a security check is performed. If he is accepted, his notification will state specifically for which type of Naval duty.

The new recruit is sent to Officer Candidate School (OCS) at Newport, R. I., where he spends four months which many consider worse than Dante's Inferno. The time is spent in continuous studying, cleaning, and drilling—with luck, some time for sleeping is allowed. About 10 percent of the class, which is entirely composed of college graduates, do not graduate, and they spend the next two years as seamen. The engineering graduate has much less trouble than his liberal arts classmate and in general does very well at OCS. At the end of four months, the recruit receives his commission and Ensign stripe. Then all talk of abolishing OCS ceases and the trying times become fond memories.

The new CEC officer

The new CEC officer gets two months of temporary duty at Port Hueneme, Calif. (60 miles north of Los Angeles). Here he attends an eight-week orientation course at the Civil Engineer Corps Officer School (CECOS), including a week of training with the Marines at Camp Pendleton. After OCS, the eight weeks in sunny California are extremely enjoyable. A detail officer for the Corps comes to CECOS for interviews as an aid in determining the next assignment. An unusually large percentage of the officers are happy with their first duty assignment. After CECOS, the new CEC officer reports to his new duty station, rolls up his sleeves, and goes to work.

Three criticisms have often been made from within the organization. "An Ensign's pay is much lower than the graduate engineer receives in civilian life." An Ensign's pay is $338.58 per month if single and $355.98 if married; this includes non-taxable allowances for subsistence and quarters. The first promotion is to lieutenant junior grade (j.g.) 18 months after being commissioned. Three years after being sworn into the Navy there is a substantial pay increase—to $484.98 if single and $502.08 if married. These wages compare more favorably with civilian salaries if such fringe benefits as free medical and dental care, thirty days leave per year, death benefits, and the use of Naval Exchange and Officer Club facilities are included.

"Lack of responsibility in many billets" is another widely heard complaint. There is no guaranteed method of avoiding such a billet, and to a large extent the responsibility a new officer receives will depend on his ability to handle responsibility, on the duty station, and on the commanding officer. Yet the same situation exists in private industry and in most instances to a much greater extent.

Thirdly, "The CEC offers little opportunity for engineers who desire only slide-rule engineering work, and no opportunity for specializing in such fields as electronics, chemistry, or atomic energy." There is little room for the specialist. Each CEC assignment covers a new phase of management and/or engineering and is intended to fully develop the officer's capability to make a wide variety of administrative and engineering decisions.

Many of us judge an organization by the personal opinions of those connected with it. The best publicity the CEC gets invariably comes from its former and present officers. The majority of them hold the Corps in very high esteem and recommend such duty, without hesitation, to most qualified and interested graduates. I myself have found my time in the CEC extremely enjoyable. If you are interested in the CEC, get the views of former and present CEC officers, and then decide. If your decision is favorable and you are accepted, I believe you will have three enjoyable and fruitful years in the Civil Engineer Corps of the Navy.

Truss developed to save material

P. H. CHENG, Structural Designer, New York, N. Y.

Dr. Cheng, a member of the Chinese Institute of Civil Engineers, Formosa, graduated from the University of Michigan in 1914 and received from Cornell University the degree of M.C.E. in 1915 and that of Ph.D. in 1917. He was engaged on Chinese Government railroads for more than 20 years before he returned to the United States.

Truss of 210-ft span was set up and successfully tested in Formosa in April 1956. This truss, shown schematically in Fig. 5, has a Class 64 loading and requires only 172 Bailey panels as compared to 378 for a regular Bailey bridge of the same span, of triple-triple construction, with a Class 29 loading. The stiffness of the Chenghwa truss was shown in the Formosa test, when a heavy tank on the structure caused deflection of only 1½ in.

A new truss design has been developed whereby the tension chord of one truss is incorporated in the compression chord of another so that tension and compression forces offset each other. The result, called the Chenghwa truss, yields a saving in material and an increase in stiffness, loading capacity, and maximum span limit. The structure is statically determinate with no ambiguity in stress distribution.

In common practice, eccentric connections are avoided, but in this truss, the eccentric connection is a basic feature of the design. Whereas dead and live loads are usually carried through floor beams to panel points, in the Chenghwa truss the floor beams are located on the chord, which may be a beam, a girder, or a subsidiary truss. This method can be applied to any type of truss—deck or through, Pratt, Warren, etc.

When a reinforced concrete T-beam is used as the top chord of a Chenghwa deck truss for a highway bridge, as in Fig. 1, the T-beam acts as a stringer for the floor system and its bottom flange acts concurrently as the top chord of the main truss. The bottom flange receives tensile stress from the bending moment of the stringer action and simultaneously it gets compressive stress from the main truss acting as top chord. Tension and compression neutralize each other to effect the saving of steel. No tension rods are required for T-beam reinforcement because there is more compression than tension. The bottom flange of the reinforced concrete T-beam is thus automatically prestressed.

A Chenghwa truss can be built of plate-girders, as in Fig. 2. Floor beams and stringers are arranged exactly the same as in a regular plate-girder bridge, but the bottom flange of the plate girder is arranged to act simultaneously as the top chord of the main truss. It receives tensile stress from the

bending moment as a girder, and at the same time it gets compressive stress from the main truss as top chord. The top flange and web of the plate-girder are not affected by this arrangement because the bending moment and shear of the girder have not been changed.

On the same principle a Chenghwa truss can be built of subsidiary trusses (Fig. 3). The top chord of the main truss, in compression, is embodied into the bottom chord of the subsidiary truss, in tension. Other arrangements, for different types of trusses, are shown in Figs. 4 through 7.

In Fig. 4, the bottom chord of the upper subsidiary truss is used for the top chord of the main truss. This long compression member is braced vertically by the subsidiary truss and horizontally by its laterals. This may lead to a new way to design long columns by using trusses to resist buckling forces, a percentage of the direct stress being applied perpendicular to the column at its mid point. The usual limitation of 40 ft on panel length would not apply to the Chenghwa truss.

In Fig. 6, a three-hinged tied arch is shown with the top chord of the subsidiary truss being used as a tie-rod without extra cost. Such an arch can be used as a roof truss or for a bridge on a difficult foundation.

In Fig. 7, multiple arches supported by a main truss replace the subsidiary trusses of Fig. 2. The top chord of the main truss—*AB*, *BC*, and *CD*—which is in compression, is used concurrently as tension tie-rods for the arches. If these members take a 1,000-ton dead-load in tension due to arch action, and also a 1,000-ton dead load in compression due to top-chord action, the resultant is zero stress for dead load, instead of a 1,000-ton tension load and 1,000-ton compression load to be taken care of separately. The top chord of the main truss therefore, can afford to help free of charge, and its own stress is greatly benefited by so doing. For the truss shown in Fig. 7, the dead-load stress is uniform from A to D, so that the dead-load tension and compression can be entirely neutralized. Since the live-load stress is not uniform, it can only be partly neutralized.

The Chenghwa truss can be designed for quick construction in emergency. Repetitive sections similar to Bailey bridge panels can be used. When such sections are stockpiled, highway bridges can be designed in a few hours and erected in a few days. These sections are foolproof because each one has a uniform standard strength. They are economical because the panel length and truss depth can be varied to give best results for each span. They can be used as a semi-permanent bridge or for a temporary structure.

The Chenghwa truss of Fig. 5, built of Bailey bridge panels, has a 210-ft span with double-single construction. Members *AB*, *BC*, and *CD* are Bailey trusses of 70-ft span with decking. The loading capacity is Class 64 (a 64-ton concentrated load at center of span). The chords of these trusses are hinged at *A*, *B*, *C*, and *D*. Members *AE*, *EF*, and *FD* are also Bailey trusses, with bracing, but without decking. Members *EB*, *EC*, *FB* and *FC* are tension members or steel-wire cables. The top chord of the Bailey truss *BC* is concurrently the bottom chord of the Chenghwa truss. This common chord gets compressive stress from the Bailey truss and also tensile stress from the Chenghwa truss.

The bottom chord and web members of the Bailey truss are not affected by this arrangement because the bending moment and shear of the Bailey truss have not been changed. Junction posts with one main pin and 10 subsidiary truss pins are used in every panel point of the main truss, top and bottom alike. The Bailey truss is built of trussed sections each 10 ft long, 5 ft high and 6½ in. wide.

It requires 378 pieces of Bailey panels to build a regular Bailey bridge of 210-ft span, triple-triple construction for Class 29 loading. However, the Chenghwa truss, with the same span, has a Class 64 loading and requires only 172 Bailey panels. Thus the Chenghwa truss has twice the loading capacity with half the material. It was tested in Formosa with complete success on April 16, 1956, as accompanying photos show.

Besides the saving in material, the Chenghwa truss has another desirable feature, its stiffness and rigidity. Bridge deflection is chiefly due to the lengthening and shortening of chords. In the Chenghwa truss, with tension offset by compression, chord lengthening and shortening are reduced. This phenomenon was spectacularly shown when the 210-ft Chenghwa bridge in Formosa (shown in the accompanying photos) was tested. Before a heavy tank moved on to the bridge, many Chinese and American engineers who had been invited to witness the test thought the deflection would be from 8 to 9 in., because the bridge had hinges at 10-ft intervals. However when the tank was on the bridge the actual deflection was only 1½ in. This extraordinarily low deflection was later verified by computation as the natural outcome of counter action between tension and compression. Such stiffness is a desirable feature because it tends to reduce maintenance.

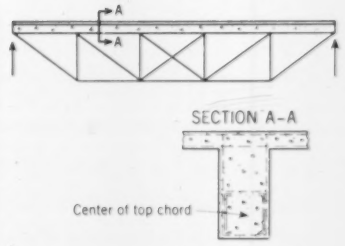


FIG. 1. Reinforced concrete T-beam forms top chord of Chenghwa truss.

FIG. 2. In deck Chenghwa truss, plate girder acts as top chord.

FIG. 3. Subsidiary truss forms top chord in deck Chenghwa truss.

FIG. 4. Through Chenghwa truss has subsidiary trusses for top chord, bottom chord, and verticals.

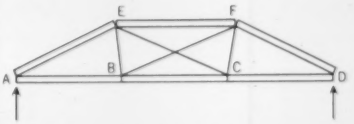


FIG. 5. Through Chenghwa truss can be built of Bailey panels. For a bridge of 210-ft span, less than half as many panels are required as for standard Bailey bridge, and loading capacity is more than doubled.

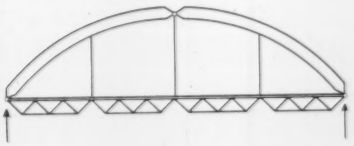


FIG. 6. Top chords of subsidiary trusses act as tie-rod for three-hinge arch.

FIG. 7. Top chord of main truss is used as tie-rod for two-hinge arch.

World's highest earth-fill dam completed

FIG. 1. Swift Project consists of two main parts: Swift No. 1, with its dam, reservoir and powerhouse, and Swift No. 2, with its afterbay, canal and powerhouse. Swift Reservoir will be largest body of water (740.00 acre-ft) in southwest Washington and northwest Oregon.

A condensation of three papers on the Swift Hydroelectric Project presented at the ASCE Portland Convention, before a session of the Soil Mechanics and Foundations Division presided over by Stanley J. Johnson, Vice Chairman of the Division's Executive Committee. Authors of the three papers are: (1) E. Robert de Luccia, M. ASCE, Vice President and Chief Engineer, Pacific Power and Light Co., Portland, Oreg., and John R. Kiely, M. ASCE, Senior Vice President, Bechtel Corporation, San Francisco, Calif.; (2) James G. Patrick, A.M. ASCE, Project Engineer, Bechtel Corporation, Vernon, Calif.; and (3) Harris H. Burke, M. ASCE, Assistant Resident Engineer, Bechtel Corporation, Cougar, Wash.

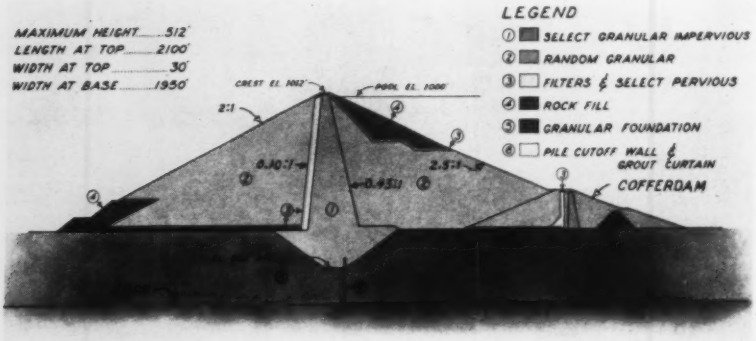
On the Lewis River in southwestern Washington, the highest earth-fill dam in the world has been topped out, and the power installation is approaching completion. The 512-ft-high dam project, part of the Swift hydroelectric project, was constructed in 30 months. In fact most of the 16,000,000 cu yd of material was placed in 18 months despite an annual average precipitation of 120 in. distributed throughout the year.

Methods developed for compacting soil with an excessive moisture content were the key to year-round work but thoughtful planning by engineers who know construction coordinated all phases for early completion. An unusual cutoff wall penetrating boulder-filled strata to rock, adds another 80 ft to the effective height of the dam.

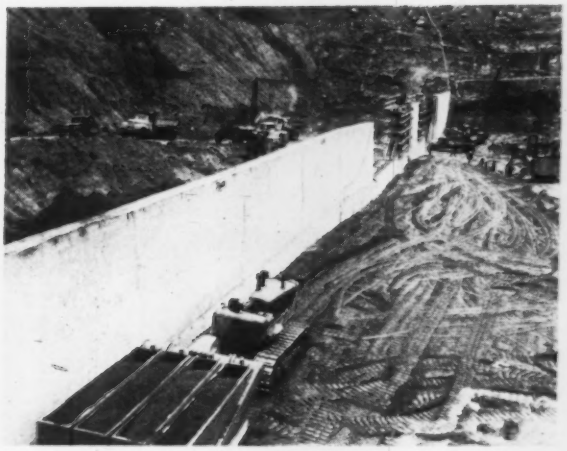
The Swift project consists essentially of two integrated parts—a dam, reservoir and powerhouse with 204,000 kw installed, called Swift No. 1, and an afterbay, canal and powerhouse with 70,000 kw installed, called Swift No. 2. See Fig. 1. The Pacific Power & Light Company is constructing Swift No. 1 and the Cowlitz County Public Utility District is constructing Swift No. 2. Bechtel Corporation is doing the design and other engineering work, including construction management, for both.

The Lewis development, of which Swift is a part, consists of five parts: (1) the Merwin project, of 100,000 kw with a third 50,000-kw unit now being installed—the project furthest downstream and the first construction undertaken—which was completed in 1931; (2) the Yale project with 108,000 kw installed, next upstream, completed in 1953; (3) the Swift project; (4) the proposed Muddy project of about 120,000 kw, for which an application for license is pending before the Federal Power Commission; and (5) above that, a proposed high-head project called Meadows (now being investigated under a preliminary permit) which would develop some 2,100 ft of head and 75,000 kw.

The Lewis River, which flows gen-



← FIG. 2. Swift Dam, to be topped out at height of 512 ft early in November, contains 16 million cu yd of material. Main embankment fill has engulfed cofferdam. →



Early in 1957, cutoff was extended below excavation by driving a row of H-section steel beams to maximum depth of 90 ft, forming a wall 300 ft long. Sheetpiles welded to beams interlocked as they were jetted and driven, three at a time, to refusal (above left). Cells 15 by 18 in. were scoured out by pump and filled with concrete. Contact zone was grouted to perfect the seal. Concrete wall of cutoff extension (above right) was nearly completed in summer of 1957. Pneumatic roller in foreground was supplemented by concrete vibrators for compaction along the wall.

erally southwest, is a tributary of the Columbia, which it enters about 25 miles downstream from Portland, Oreg. It is typical of streams west of the Cascade Range, being fed by glaciers on the slopes of Mt. Adams and Mt. St. Helens and by general snowmelt and rainfall. The mean monthly flow for an average water year varies from a high of 4,400 cfs to a low of 950 cfs in September. The highest recorded instantaneous flow was 54,000 cfs.

The Lewis River Basin has a moderately rugged topography and is heavily forested. It varies in elevation from 600 ft at the dam site to a general average of about 4,000 ft along the ridges, capped by Mt. Adams and Mt. St. Helens which rise to about 9,000 ft.

Bedrock at the dam site is of volcanic origin, composed chiefly of consolidated sediments from an early episode of volcanic activity, and is a remnant of the ancestral Cascade Mountains. Subsequent intermittent volcanic activity, glaciation, and torrential flows have caused extensive changes in the drainage pattern. One of these changes resulted in a new and higher river channel offering a suitable site for the Swift Dam.

Explorations at the site showed about 50 ft of coarse gravel, cobbles and boulders, and beneath this top layer, 150 ft of finer material containing strata of sand and gravel and occasional boulders. The great depth to rock in the river section and the absence of rock above El. 800 at the north abutment discouraged consideration of any type of dam except an earthfill. See Fig. 2.

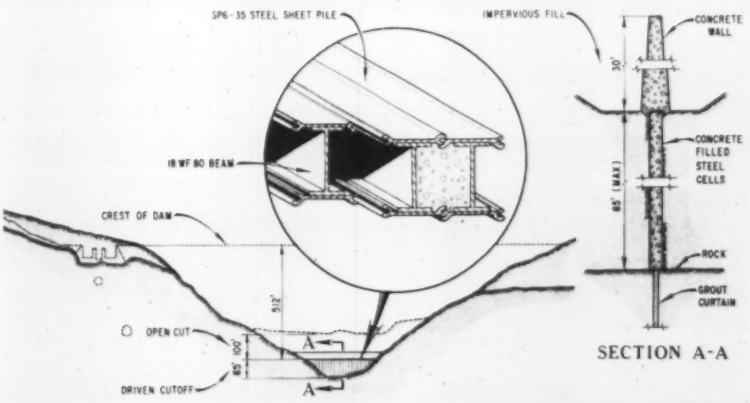
The design of an earthfill dam of unprecedented height, 420 ft above stream bed and 600 ft above rock, with 200 ft of river sediment under it, presented a real challenge. On the credit side were the readily available borrow materials, which have a high degree of impermeability and high structural strength and can be handled in very wet weather.

Field classification and results of laboratory tests showed that all foundation and borrow materials were nonplastic and possessed of high shear strength. The permeability varied from the highly pervious stream-bed and alluvial terrace materials to the relatively impervious mudflow and slope-wash materials. The predominant material available for borrow was the relatively impervious reworked mudflow found in large terrace deposits a short distance up Swift Creek and on the north bank of the Lewis River downstream from the dam site. This is a well graded material containing 5 to 20 percent of fines.

A limited quantity of river-deposited sandy gravel with cobbles was available at the dam site. However, 1.5 miles upstream there are large quantities of relatively clean sand and gravel.

As the design and cost of the embankment depended to a great extent on the ability to place the silty deposits during periods of rainfall, a test fill was constructed under simulated rainy conditions. This was accomplished by means of a "Rainbird" sprinkler system which had a capacity of 2 in. of simulated rainfall per hour. The test embankment showed that mudflow materials having as much as 15 percent fines could be placed and compacted during relatively heavy rainfall, provided certain precautions, detailed later, were observed.

Topographic features at the site were suitable for the proposed high earthfill dam. A narrow rock bench at about crest level on the south abutment offered a natural location for the spillway. It could discharge at a jump-off structure 300 ft above streambed, well below the power-plant location.



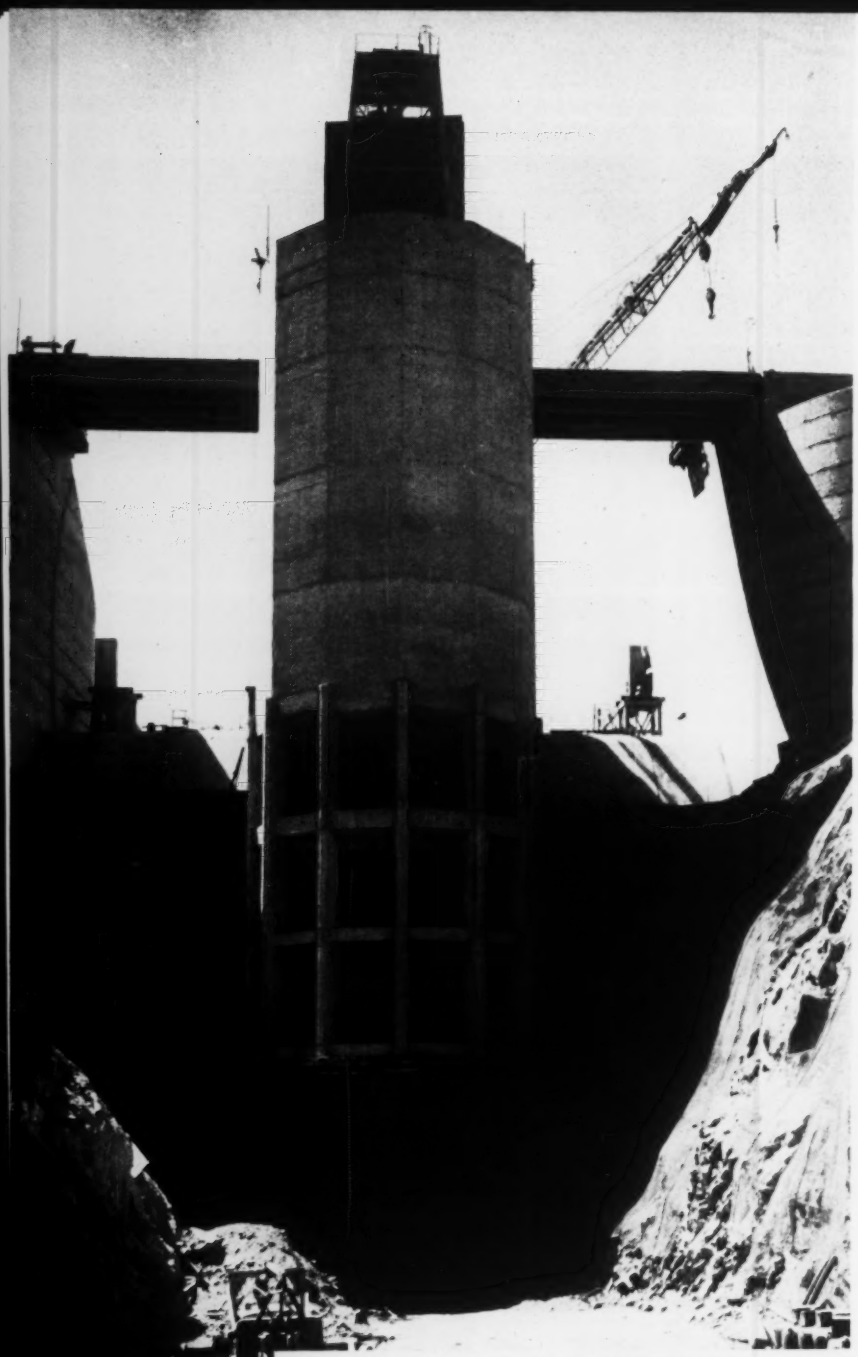
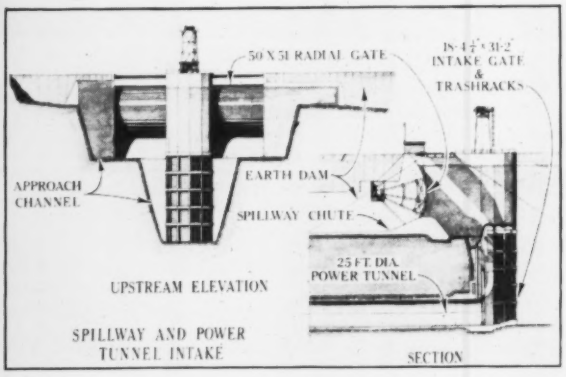


FIG. 3. Spillway and power-tunnel intake for Swift Dam are combined in one structure.



The south abutment also offered the most feasible location for the required power tunnel. It became evident that deepening the spillway to provide an approach channel to the power intake structure would be less costly than an equivalent length of steel and concrete-lined tunnel. Rock suitable for rip-rap would also become available. The power intake structure was combined with the spillway structure by making it an integral part of the spillway center pier.

The spillway is an ogee-crest structure controlled by two radial gates 50 ft wide by 51 ft high, which discharge into a concrete-lined chute. It is designed to pass a maximum flow of 150,000 cfs, about three times the maximum flood of record.

The intake structure, in the center of the spillway, is 45 ft wide and rises 160 ft from the base of the intake channel to the dam crest elevation. The upstream nose of the structure consists of six chords arranged in a semicircle, which assures smooth approach-flow conditions for the spillway.

The power tunnel, Fig. 3, is located about 100 ft below the spillway crest. This tunnel of 25-ft diameter is on a flat gradient for about 1,000 ft of its 1,450-ft length and then is steeply inclined. It finally divides into three branches each of 13-ft diameter, leading to the three turbines. At the head of the inclined section is a 55-ft-diameter, orifice-type surge tank. The power tunnel and surge tank are lined with steel and concrete throughout, with provision for grouting the steel-concrete and the concrete-rock contacts as well as the surrounding rock.

Deep cutoff wall

With the general planning for an earthfill dam completed, a positive cutoff wall to bedrock was the first design requirement. Several types were considered including a full open cut, a narrow sheeted trench, overlapping caissons, sheetpiling and grouting. Comparative studies showed that a combination of an open cut and a driven cutoff wall would be the most practical. An open cut was made for a depth of about 100 ft below stream bed and a positive membrane was driven from the bottom of this excavation about 80 ft to rock. This cutoff wall consists of 18-in. steel beams with a flat sheetpile welded to each flange. See Fig. 2. These units were driven in interlock to rock. Cells formed by the adjacent beams and piles were excavated and filled with concrete to provide a positive cutoff.

Two cranes were used in this operation, one for setting piles and handling the jet and the other for the pile-driving hammer. A Super Vulcan differential-acting hammer, delivering 30,000 ft-lb per blow at 104 blows per min, was used first for driving three piles at a

time. However, special cast-steel triple heads were not too successful and later the piles were driven with a single head. A 6-in., two-stage, high-pressure pump was used for jetting.

To prevent damage to the piles, restrictions were established on the number of blows per foot. When driving reached the limit so established, the hammer was stopped until the penetration could be eased by jetting before driving was resumed. In addition, throughout the driving process, the jet was kept working in the adjacent piles or alongside the pile being driven. Initially, for the upper portion of the driving, only one blow of the hammer per foot of penetration per foot of depth was allowed, but as the driving progressed, this restriction was eased to $1\frac{1}{2}$ blows per foot per foot of depth, with a maximum of 120 blows per foot.

Outside jetting did not appear to be as successful as that inside the cell owing to the difficulty with which the jet pierced the hard layers of pumice, and because of the accumulation of coarse material, which had a tendency to follow the jet down alongside the piles. Obstructions were removed by chopping with a heavy bit inside the cells.

When the piles had reached what appeared to be bedrock, a series of NX ($2\frac{15}{16}$-in.) exploratory holes were drilled on 20-ft centers through the pile cells to determine the profile of the sound rock line. After the piles had reached rock, as determined by exploratory drilling, they were seated by heavy driving at a rate of 50 blows per inch. Material in the cells was removed by means of a Portuguese pump or air lift, and the cells were filled with tremie concrete. Before filling, grout pipes had been placed in every fourth pile cell, and a grout curtain 20 ft into bedrock provided positive contact.

A concrete cutoff wall 30 ft high was built above the sheetpile wall. Internal-type concrete vibrators were used for compacting selected grey mudflow material along the wall. A series of tests were conducted to determine the relative degree of compaction obtained with internal vibratory compactors as compared with normal air-powered tampers. It was found that essentially the same degree of compaction was obtained by the two methods but since the internal vibrators could easily compact material placed in 15-in. lifts, while the tampers required thinner lifts, the amount of work expended was considerably less with the vibrators than with the tampers.

Construction of the mass embankment was fairly routine. The use of rather thick layers, 15 in. for mudflow or slope-wash materials and 24 in. for

During wet-weather construction of embankment, there was considerable runoff in roller tracks. The central portion of the dam was built higher than the edges to accelerate runoff. Placing generally was done perpendicular to the axis and rolling done in that direction to force water off the fill rather than trapping it in longitudinal depressions.

Impressive bulk of Pacific Power & Light Company's Swift Dam is evident in view across downstream face. Loaded earth haulers in foreground are headed for dam top, which must go up another 112 ft before $56,000,000 project will be completed. Across valley, mountainside has been cut away for forebay and spillway channel. Power tunnel 1,575 ft long will feed 250,000-kw powerhouse at lower right.

alluvial sand and gravel, effected a considerable economy in the construction but precluded some of the usual methods such as scarifying. It was not feasible to scarify the embankment because of the high content of large rock. Also, it was found that the larger rock tended to make the surface relatively rough, but this was not considered detrimental. The embankment material readily absorbed water, and since it was workable in a wide range of moisture content, scarifying was not absolutely essential to the proper conditioning of the fill. The only complicating factor in embankment placing during the summer months was to provide enough water. The moisture capacity of the materials was very high, and it was a constant problem to obtain enough water for satisfactory compaction.

For wet-weather placing, every effort was made to minimize the water content of the soil as it was placed on the dam. Borrow areas, as well as embankment placement areas, were drained to eliminate excess water. The central portion of the dam was constructed higher than the outer shells so that the fill area was sloped as steeply as 8 to 10 percent. This steep slope allowed rapid drainage of water that fell on the fill and minimized the inclusion of rain in the embankment. Placement was arranged in a direction essentially perpendicular to the axis of the dam in the shell zones, although placement of the impervious core was in a direction parallel with the axis to prevent formation of more permeable zones through the core due to segregation or by washing out of the fines from between the rows of dumped material. Rolling generally was done in the same direction as placement to permit drainage of excess water down the roller tracks.

It was found that embankment placement could be carried on successfully in rains yielding a precipitation of 2 to 3 in. per day. Paradoxically, slower, steady rains of relatively light intensity were found to be detrimental. The heavy rains quickly developed surface drainage and permitted rapid runoff while the lighter rains tended to soak into the fill and increase the moisture content of the unrolled material.

Even when the fill became completely saturated, the mudflow materials could be satisfactorily worked by eliminating the excess water. This was done by additional manipulation such as by track walking the lift with a crawler-type tractor. Track walking consisted of covering the entire surface of the fill successively with the tread marks of a crawler tractor, preferably one having small cleats or none on the tracks.

The combination of pressure and vibration of the tractor in track walking brought the excess water to the surface and the slope of the fill allowed it to run off. Generally lifts were started toward the center of the embankment and carried toward the shoulders.

Three methods were developed for stabilizing soft spots that occurred in the course of construction. The most common was merely to allow time for the fill to drain until it reached the proper water content prior to rolling. It was quite common for the fill to drain even during periods of heavy rainfall when adequately sloped and smoothed to eliminate pockets on the surface. Simple drainage was the most usual practice and could be accomplished satisfactorily in nearly all areas. Sometimes it was necessary to manipulate the fill by track walking to decrease the water content, especially in the impervious zone. In a very few stubborn spots, which did not respond satisfactorily, materials were removed and replaced. The wet material was spread in thin layers on adjacent drier material.

A wide variety of excavating and hauling equipment was used for handling the 16,000,000 cu yd of material at Swift Dam. Eleven shovels and draglines ranging from a 7-cu yd down to a 1½-cu yd unit were used for excavating. Hauling equipment consisted of 53 bottom-dump and end-dump Euclid trucks supplemented by smaller trucks for hauling aggregates. All the hauling units had sideboards to increase their capacity. Five water trucks with tanks ranging from 2,000 to 5,000 gal were used for wetting the fill and sprinkling the haul roads. Rock in the upstream draw-down zone was sluiced into place with a hydraulic monitor.

Loading time ranged from 1½ min when loading under a large excavator, to 4 min when loading under the smaller shovels. Cuts generally were kept to about the shipper-shaft level and ranged from 10 to 26 ft. Placing was carried on at from two to five dumping points. Because of the difficulty of placing the rather rocky material on the fill, an unusually large number of bulldozers, from seven to nine, were required. Two 50-ton rubber-tired rollers pulled by crawler tractors were used for compaction. Embankment operations have been on a two-shift basis, the shifts ranging from 8 to 10 hours depending on the season.

The power installation is somewhat dwarfed by the huge earth-fill dam and the unusual conditions of placing. However, it has been an interesting piece of work.

The powerhouse is an indoor-type structure with structural steel and aluminum siding above the generator floor. The indoor type was selected primarily to keep the required overall width to a minimum because of the limited area available under the high rock face. The structure is located on the south side of the river just downstream from the toe of the dam and contains three units, powered by 107,000-hp Francis turbines rated at a 320-ft net head, each directly connected to a generator rated at 75,750 kva at 0.9 power factor (68,000 kw).

Three three-phase transformers are located on the downstream deck of the powerhouse. Overhead lines lead to a 230-kv switchyard located on the north side of the river. Turbines and butterfly valves are being furnished by S. Morgan Smith & Co. and electric equipment by General Electric.

The Swift No. 2 plant consists of a canal 3.5 miles long from Powerhouse No. 1 to Powerhouse No. 2, where a head of 113 ft develops 70,000 kw in two 35,000-kw Francis turbine units. The tailrace of the powerhouse is at the head of the Yale storage reservoir. The canal, except in its upper part, is essentially an elongated lake, one side being bounded by a dike along the river and the other following the natural contours of the hillside.

Swift Station No. 1 is designed for minimum attendance, utilizing only one operator per shift to start and stop the units, to operate all auxiliary equipment, and to acknowledge station alarms. Speed and load are supervisorily controlled by micro-wave from the downstream Merwin Plant. Swift No. 2 is a fully automatic, unattended station with complete supervisory control from Swift No. 1.

Building the world's highest rolled-fill dam in 2½ years required close coordination of contract awards and construction. Normally, a winter flood season is not the time to make a deep excavation in the bed of a river, but the benefits to be obtained by completing the cutoff wall during the winter of 1956-1957, so that fill placement could start in the spring of 1957, far outweighed the possible losses from overtopping of the cofferdam. Therefore the unlined horseshoe diversion tunnel, 3,000 ft long and 36 ft in diameter, was started in May 1956 with diversion scheduled for early October 1956, before the flood season. The tunnel was driven from both ends. Steel support was required for 5 percent of its length.

While the diversion tunnel was being excavated, bids were taken for excavation of the cutoff trench and driving of the cutoff wall. The bids submitted indicated high contingency factors for handling water in the deep cutoff and were considerably over the engineering estimate. Consequently excavation in the river bed was started under a

force account contract. The amount of dewatering necessary proved to be less than the most optimistic estimate, and the dewatering was accomplished by pumping from sumps. With the contingencies thus removed, bids were called for completion of the cutoff and construction of the dam and hydraulic features.

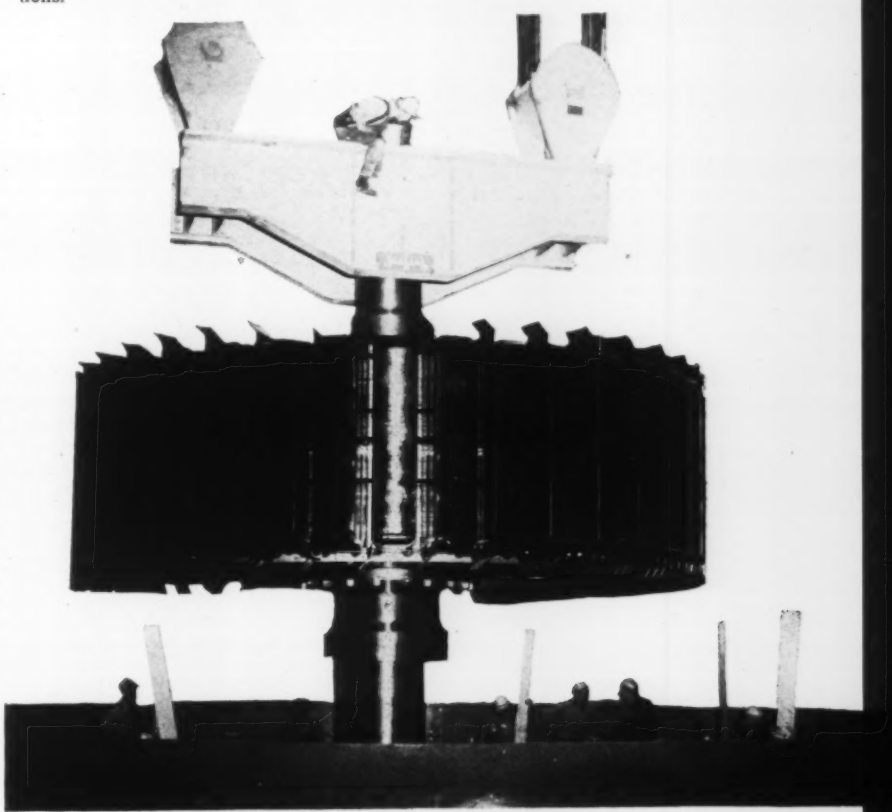
The river was diverted through the tunnel on October 8, 1956. On November 3 a joint venture composed of the J. A. Jones Construction Co. and the Chas. H. Tompkins Co. commenced operations under a contract to construct the dam, spillway, power tunnel, and related work. Excavation of the trench for the cutoff wall was started the next day. The last cutoff-wall steel pile was seated in bedrock on April 10, 1957, and the tremie concrete operation was completed April 24.

Contracts were awarded to the Guy A. Atkinson Co. for construction of Swift Project No. 2, including the canal, intake structure, Powerhouse No. 2 and related work in May 1957. In June a second contract was awarded to the same contractor for the construction of Powerhouse No. 1. These contracts included complete construction and installation of all equipment in the powerhouses.

After the cutoff trench had been backfilled and the embankment brought to river grade, the rate of fill placement increased rapidly, reaching a maximum daily rate of some 66,500 cu yd. By the end of October 1957, a total of 6,400,000 cu yd had been placed. The embankment was 120 ft above the stream bed and about 40 percent complete. During last December and January, when 47 in. of rainfall was being recorded and the hauling equipment was being overhauled, the rate of fill placement fell to 20,000 cu yd per day.

By June of 1958, when a group attending the ASCE Convention in Portland visited the site, some 13,000,000 cu yd of material was in place and the dam had reached 390 ft above the foundation. Despite a general area strike of equipment operators and drivers from July 9 through August 14, the dam will be topped out at a height of 512 ft and a fill content of some 16,000,000 cu yd in early November. It is expected that enough water can be retained to permit testing and some power production in early December, ahead of the completion schedule. The contract carries a "penalty-bonus" clause of $3,000 per day.

The cost of Swift Dam No. 1 is estimated at $58,000,000 and that of Swift No. 2 at $17,000,000, a total of $75,000,000.



Scroll cases for Swift No. 1 powerhouse are 42 ft in diameter. Steel of 90,000-psi yield point was used for 50-percent weight reduction and easier fabrication. View below shows installation of rotor of 21-ft 8-in. diameter, with 23-ft shaft. Three 68,000-kw units are to be installed in Swift No. 1 powerhouse for Pacific Power & Light Company, and two 35,000-kw units downstream in Swift No. 2, for Cowlitz County, Wash. The two plants will produce 924,000,000 kwhr annually under average water conditions.

PRESTRESSED CONCRETE for AIRFIELD PAVEMENTS

GUNNAR S. PEDERSEN, M.ASCE, Lt. Col., Norwegian Army; Military District Engineer, Trondheim, Norway

Prestressed concrete, steadily conquering new fields, has already proven its effectiveness for airfield pavements. As early as 1945 considerable lengths were prestressed but the first practical application of prestressing to airfield pavements on a large scale was made in 1953-1954, with the expansion of the Airfield Maison Blanche at Algiers. The runway, 8,000 ft long and 200 ft wide, and the parallel taxiway 80 ft wide built at that time, using prestressed concrete, have very satisfactorily withstood four years of heavy traffic.

One of the main problems with concrete airfield pavements is cracking due to tensional stresses from shrinkage and temperature variations. By keeping the concrete in compression through prestressing, the bearing capacity of the pavement is increased considerably and cracking is either reduced or completely eliminated.

Another advantage of prestressed concrete is that, by adequate arrangement of the prestressing, the number of joints can be reduced to a minimum. This is especially advantageous for airfields used by jet aircraft because transverse joints, even when carefully constructed, cause vibrations in planes landing at high speeds. These vibrations disturb the electronic equipment and thereby increase the cost of plane maintenance.

When prestressing is applied over a considerable length of pavement 4 to 8 in. thick, there is a risk of buckling. However, the weight of the pavement resting directly on the base counteracts the buckling tendency. Crushing of the concrete will take place before buckling as long as the pressure line does not rise too far above the center line of the cross section.

Another problem is "friction" between the concrete pavement and the base. This so-called "friction," which is actually a combination of friction and deformation of the base and subgrade, occurs when the pavement expands and contracts as the result of temperature and moisture variations. Tests have shown that the "friction" does not depend solely on the evenness of the contact surface and the material in the base and subgrade, but is also highly dependent upon the rate at which the movement takes place. In a concrete pavement that can move freely during changes in temperature, the friction can produce tension stresses that reduce or altogether eliminate the prestress in parts of the pavement. By fixing the concrete pavement between permanent abutments, such friction can be almost completely suppressed. However the temperature stresses become an important factor.

Tests at Orly Airfield

The first practical experiment with prestressed concrete for airfields was carried out at Orly Airfield near Paris in 1945. The well known French concrete designer, M. Freyssinet, was asked by the Paris Airfield authorities to produce plans for a 1,380-ft extension to the main runway at Orly, to be constructed of prestressed concrete. The extension was designed for an 85-ton wheel load, with a thickness of 6.3 in., prestressed to 480 psi. The pavement was composed of prefabricated concrete slabs one meter square (3 ft 3 in.).

Prestressing of the runway in a crosswise direction was accomplished by cables 3 ft 3 in. apart. Lengthwise prestressing was achieved by dividing the runway into triangles with joints fitted with steel rollers, each joint running across the pavement at an angle of 45 deg with the runway center-line. This longitudinal prestress is absorbed at

Maison Blanche Airfield, Algiers, has prestressed concrete runway 8,000 ft long and 200 ft wide. This and parallel taxiway 80 ft wide have withstood nearly four years of heavy traffic.

each end of the runway extension by a rigid abutment which is anchored in the subbase beneath the pavement. The runway has been in use for ten years and has performed successfully without any cost for maintenance.

In 1947 a similar prestressed section of concrete runway 240 ft long was built at Melsbroeck Airfield near Brussels. At the London Airport a 360-ft length of runway was built in 1949 by the same method. Both these runways have performed satisfactorily.

The reason why this type of prestressed pavement has not been employed more frequently is that ordinary concrete spreading and finishing machines are not suitable for placing it. Also, the joints are complicated, so that such pavements cannot compete in cost with conventional concrete pavement.

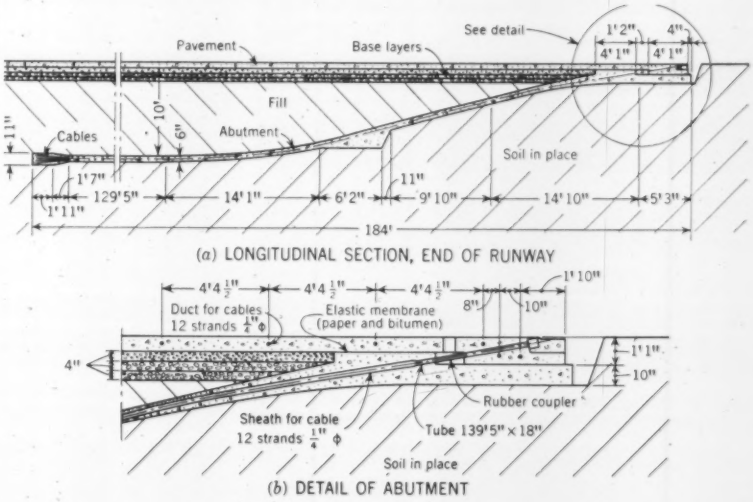
In 1953 a new test pavement was constructed at Orly Airfield for a taxiway 1,400 ft long. M. Freyssinet had been asked to make plans for a prestressed pavement that could compete with conventional pavements in performance as well as in economy. This pavement was placed with ordinary concrete spreading and finishing machines in strips 16 ft 6 in. wide and 7.1 in. thick. Transversely the pavement is prestressed to 250 psi by means of twelve ¼-in. cables spaced 4 ft 4 in. apart. At each end of the runway the pavement is anchored in a fixed abutment similar to that in the Algiers runway, shown in Fig. 1. Longitudinal prestressing is produced without cables, by the use of a special hydraulic jack which pushes the concrete against the abutments.

After completion, the pavement was thoroughly tested. According to test results its bearing strength was evaluated as a 60-ton wheel load at a 185-psi tire pressure, or a 100-ton wheel load for restricted traffic with a 314-psi tire pressure. In addition to a number of shrinkage cracks which appeared during the first part of the construction period, some cracks appeared in the pavement in the winter of 1955-1956 during a period of hard freezing. These cracks closed when the temperature rose. Later, pressure was put on the hydraulic jacks again, and since then no more cracks have appeared. Apart from these cracks the pavement up to now has performed satisfactorily. Actually, when the concrete is under pressure, the cracks have no effect on the bearing capacity.

Airfield at Maison Blanche, Algiers

For the construction of the airfield at Maison Blanche, Algiers, bids were invited on two alternatives, one a 14.5-in. plain concrete pavement resting on a gravel base 16 in. thick, and the other a 5.5-in. asphalt pavement on a 34-in. base. The firm that previously had constructed the prestressed pavement at Orly Airfield in 1953 proposed as a third alternative a prestressed concrete pavement 7.1 in. thick on a 12-in. base. Because of its economy, this third alternative was considered the most favorable and was adopted.

FIG. 1. Prestressed concrete pavement at Maison Blanche Airfield, Algiers, has performed satisfactorily under heavy traffic for two years. Longitudinal prestressing is accomplished without cables, by hydraulic jacks which push pavement against underground abutments at each end of taxiway.



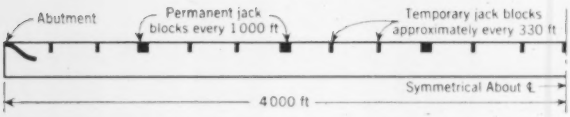

Abutment
Permanent jack blocks every 1 000 ft
Temporary jack blocks approximately every 330 ft
Symmetrical About ℄
4 000 ft

FIG. 2. Schematic longitudinal section through Maison Blanche runway shows location of jack blocks which prestress pavement.

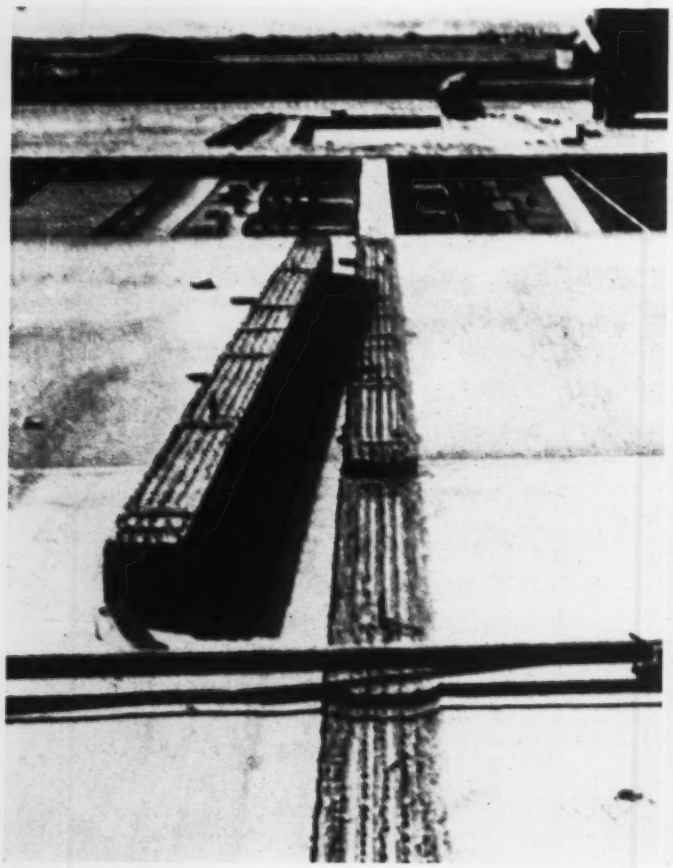
For two years the pavements at Maison Blanche have been subjected to intensive use, including heavy traffic to and from the oilfields in the Sahara, and have behaved very satisfactorily. There are a few fine cracks in the surfacing, caused by inadequate pressure on the hydraulic jacks during construction, while concrete shrinkage was taking place. The pavement is now under full stress and the cracks have no effect on its bearing capacity or evenness.

On the Maison Blanche runway, the subgrade consists of a fine grained soil which can be described as a silty clay. When soaked it swells up to 5 percent. The liquid limit is 50 to 55 and the plasticity index varies between 30 and 37. A coefficient of subgrade reaction of 160 lb per cu in. and a California bearing ratio of 7 percent were used for design of the base and pavement. The base is built up of three layers, each 4 in. thick. The bottom layer consists of river gravel; the middle layer, which acts to break capillary action, consists of washed river gravel; and the top layer is composed of water-bound macadam made of crushed chalk stone, impregnated with bitumen. To reduce friction, a layer of sea sand 1 in. thick was placed on top of this foundation, and the sand layer in turn was covered with a layer of watertight craft paper. See Fig. 1.

Drainage is provided by longitudinal surface-water channels along both sides of the runway, which has a transverse slope from the crown toward each side of 0.5 to 1.5 percent. The water enters the channels through a continuous slit. In addition, the previously mentioned 4-in.-thick drainage layer in the base discharges through ordinary drain pipes on each side of the runway.

Abutments absorb prestress

The abutments, which absorb the longitudinal prestress at the ends of the 8,000-ft runway, consist of concrete slabs 6 in. thick, which extend for the full 200-ft width of the runway. They also extend lengthwise for a distance of 184 ft at a depth of 10 ft. At each end of the runway these slabs rise in a gentle S-shape to the surface level, as shown in Fig. 1. Instead of absorbing the prestress as direct pressure in the abutments, the ends of the runway are anchored by twelve ¼-in. cables, which are placed in the abutment slab for their full length and anchored at the slab's innermost edge. The distance between cables is 1 ft 4 in. Bitumen is injected around the cables. This construction allows for a little movement between the ends of the run-



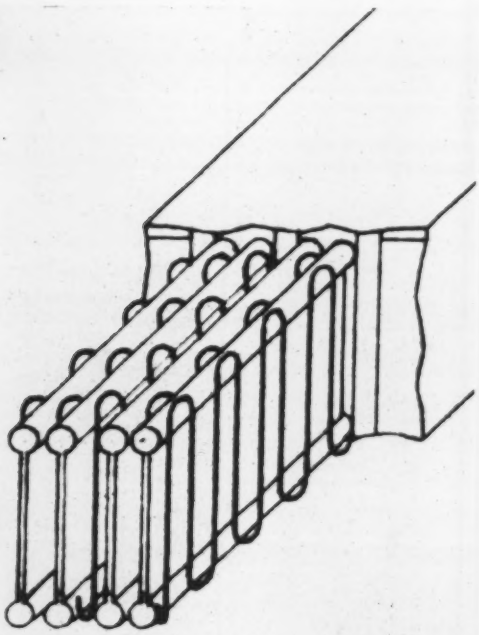


FIG. 3. Jack block, shown in sketch and photo, consists of four long flat steel containers cast together in concrete blocks 6.7 in. X 10 in. X 20 ft. When containers are put under water pressure, one at a time, they expand and push concrete toward abutments at ends.

way and the abutments, so that the abutments can be designed for a considerably lower total prestress force than if they had to absorb the pressure directly.

The runway pavement is 7.1 in. thick and has a bending strength after 28 days of 1,000 psi. The compression strength after 28 days is 5,600 to 6,400 psi. For better workability, an air entraining agent was used. The pavement was placed with ordinary concrete spreading and finishing machines in strips 20 ft. wide. Transversely the pavement is prestressed with twelve ¼-in. wires at a spacing of 4 ft 4 in. Each cable is prestressed to 43,100 tons, which gives a prestress in the concrete of 250 psi, and is then grouted with cement mortar.

Longitudinally the pavement is prestressed by hydraulic-jack blocks. A photograph and Fig. 2 show the placing of the jack blocks in gaps in the concrete pavement every 1,000 ft. A schematic sketch, Fig. 3, shows the construction of a jack block. Each jack block consists of four long, flat steel containers, which are cast together in a concrete block 6.7 in. high, 10 in. wide, and 20 ft long. When the jack is ready to function, the containers are put under high water pressure, one at a time. They expand and push against the concrete. After the desired compression of the concrete has been reached, the containers are filled with cement mortar. Finally the joint over the block is filled with mortar and leveled off.

By means of the hydraulic-jack blocks, the concrete pavement is given a minimum prestress of 250 psi at its lowest temperature and moisture content. The prestressing force is absorbed partly by friction against the foundation and partly by the abutments at each end of the runway. Since at Maison Blanche the temperature varies between 32 and 122 deg F, the prestress in the pavement varies from 250 to 1,250 psi. As long as the hydraulic jacks are filled with water they act as movable joints. To prevent possible vertical displacement of the concrete pavement on both sides of them, the pavement ends are vertically interlocked by prongs sticking out from both ends underneath the pavement.

Full prestress can first be applied after the runway is completed to its full length and the pavement has had time to harden sufficiently. As there are no contraction joints in the pavement, shrinkage and temperature cracks would have occurred if special precautions had not been taken. These cracks in themselves do no harm since they close as soon as the pavement is prestressed. But impurities can penetrate the cracks while they are open. To avoid such cracks the pavement is temporarily put under prestress, while it is hardening, by means of temporary jacks consisting of only one steel container but otherwise of the same construction as the main hydraulic jacks.

The temporary jacks were placed at 330-ft intervals along the runway. To avoid having to provide the complicated tiedown under the pavement in those places, the pressure in the temporary jacks was continuously controlled so that the degree of prestress in the concrete in the hardening period never exceeded 214 psi. When prestressing was applied by the main jacks, only one of the four containers in each jack block was used to apply the necessary force. The idea was to use the next two containers during the first year to after-stress the pavement to compensate for creep of the concrete. The fourth container was held in reserve. Up to the present, the pavement has received only one after-stressing.

Stresses continually recorded

Load tests and several years of practical experience have provided a solid foundation for estimating the strength and dependability of prestressed concrete pavements for airfields. To obtain further information for design and construction, the airfield engineers of the French department of Ponts et Chaussées are making careful observations on the behavior of the pavements at Maison Blanche in Algiers, under the supervision of M. Pousse, Director of the Construction Service for the Algerian Airfields.

Of special interest is how much the prestress in the pavement is affected by variations in temperature and moisture and, through the years, by the creep of the concrete. The fourth container of a number of the hydraulic-jack blocks was filled with oil and connected to self-registering manometers, which draw continuous curves of the variations in stress at various points in the pavement. At the same time the air temperature and the temperature in the concrete near the top, middle, and bottom of the pavement are registered. Similarly precipitation on the airfield is registered so that the amount of moisture in the pavement can be estimated.

Measurements to date show that the prestress varies with variations in temperature, and that variations in moisture have only a secondary effect. At the ends of the runway, where the concrete pavement can move a little in relation to the abutments, measurements are also taken of the expansion and contraction of the runway. These measurements are of the greatest importance for a better knowledge of the friction between the concrete pavement and the base. Measurements are also taken to establish whether the abutments move.

Algerian experience aids Norway

At first glance it may seem rather strange to apply experience gained in North Africa to conditions in Norway. The most important factor, temperature, varies at Maison Blanche from 32 to 122 deg F. Many places in Norway show temperature variations of about the same magnitude, that is, from −4 deg to +86 deg F. At Maison Blanche the ground does not freeze, but the soil is a silty clay that swells up to 5 per cent in the rainy season. The procedure followed at Maison Blanche—draining and replacement of bad soils—must also be followed in Norway.

Most Norwegian airfields, including those used by civil aviation, were built by the armed forces for fighter planes and are now used by heavier and heavier transport and passenger planes. Some airfields are already overloaded and must undergo considerable strengthening or reconstruction.

The Scandinavian Airlines System is operating planes with a total weight of 65 tons; the new DC-8 jet planes now on order will weigh 130 tons when fully loaded. There are no technical difficulties connected with the construction of airfields for heavy planes by conventional methods, but it is expensive. Therefore there is every reason to consider whether new methods, such as prestressing, can give a more economical solution.

Prestressing existing pavements

Several of our early airfields are still in very good condition. With a pavement thickness of only 6 to 8 in. and with constantly increasing plane loads and traffic, they will soon be damaged by overloading. Strengthening these pavements by prestressing is being studied. As the runways will be lengthened, abutments of the Maison Blanche type can be installed easily. More difficult to solve are such problems as how the transverse prestressing can be arranged and how the existing joints will influence the construction. Each airfield must be treated individually. Soil conditions, construction of the foundation, and the condition of the pavement must all be carefully examined. Perhaps it will be necessary to develop special machinery to cut out the joints.

M. Freyssinet is working on this problem. Its successful solution would have great economic advantages not only for Norway but for all countries where thin concrete pavements are in need of strengthening to take heavier loads.

ELECTRONIC COMPUTERS used in design of two double-deck tied-arch bridges

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The electronic computer has become an indispensable tool of the civil engineer. We find the computer doing the tedious, repetitive, and lengthy mathematical computations which until now have taken a sizable part of the engineer's time.

Our first contact with computers was over three years ago for the design of the Fort Pitt Bridge, a double-deck tied arch of 750-ft span. The computer not only performed the mathematical computations at a fantastic speed but also determined the stresses in this highly indeterminate structure in an exact manner that would have been almost impossible to do by manpower alone.

The Fort Pitt Bridge, now being erected in Pittsburgh, Pa., over the Monongahela River, will serve as the link between the East and West Penn-Lincoln Parkway, the life line of Pittsburgh.

A similar bridge, the Fort Duquesne Bridge, on the other side of Pittsburgh's Golden Triangle, spans the Allegheny River and will be the major route to the area northwest of Pittsburgh. The design for this bridge was completed a year ago, also with the aid of a computer. This route will ultimately be connected to the Pennsylvania Turnpike.

Fort Pitt Bridge design

A simple-span arch was selected for the Fort Pitt Bridge because of a limited approach distance at both ends of the span and because of its esthetic appearance. The tension tie of course eliminates the horizontal thrust on the piers. The rib is made up of box girders 5 ft deep, hinged only at the spring line. The stiffening truss, which also serves as the tie, is 25 ft in depth. There are 14 hangers, spaced 50 ft apart. Each hanger consists of four 3½-in. round cables. The bridge will carry two levels of traffic, four lanes one way on each deck. The upper deck is at the level of the top chords of the stiffening truss, while the lower deck is at the level of the bottom chords. In fact, the Fort Pitt Bridge will be the first bridge ever built that has the following three characteristics: (1) a two-hinged box-girder arch, (2) a stiffening truss as a tie, and (3) a double deck.

Because of its unique nature, a 100:1 scale model was constructed to investigate the stress and load relationship. The model is made up of machine-tooled steel members, with lead weights as dead and live loads. Strains in various members were measured by SR4 gages, and bridge deflections were measured by an Ames dial. By varying the position of a unit load, influence lines were obtained.

In plotting the influence line for stress in the hangers (measured strain times the known modulus of elasticity), an unusual characteristic was observed. The influence line has a peak when the load is applied directly at the hanger in question. As illustrated by the broken line in Fig. 1, the influence line for stress in hanger No. 5, there is a sharp peak when the unit load is at hanger point No. 5. This same phenomenon is true for all other hangers. At first this was believed to be an experimental error. A preliminary simplified theoretical analysis based on the assumption that the arch rib is hinged at every hanger point showed no such peaks. The assumption reduced the bridge to a one-degree statically indeterminate structure and gave smooth influence lines for hangers.

The bridge is actually statically indeterminate to the fifteenth degree. An easy way to visualize it is to divide the structure into two free bodies—the arch rib and the stiffening truss. See Fig. 2. The forces applied on the arch are the hanger forces, F_1 to F_{14} as shown, the horizontal thrust H, and the vertical reactions at the springing lines. Forces equal but opposite to those on the rib are applied on the truss with the addition of the external loads, in this case, a unit load of 1 kip at panel point No. 1, and the pier reactions.

The 14 hanger forces and the thrust H make up the 15 unknowns. They must be of such magnitude that continuity between the arch rib and the stiffening truss is maintained under any condition of loading. In other words, the vertical deflection of the rib (Δ_{rib}) at any hanger point plus the elongation of the corresponding hanger (e_{hanger}) must equal the vertical deflection of the stiffening truss (δ_{truss}) at the same hanger point. That is, for vertical continuity,

$$\Delta_{rib} + e_{hanger} = \delta_{truss}$$

Fourteen equations of vertical continuity are developed as there are 14 hanger points. The fifteenth equation comes from the horizontal continuity. The change in the horizontal distance

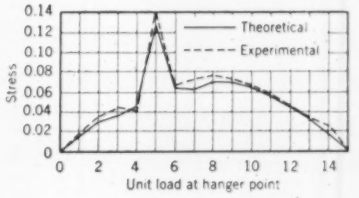


FIG. 1. Influence line for stress in hanger No. 5 from model study indicates a maximum stress in this hanger when the unit load was placed at panel point No. 5.

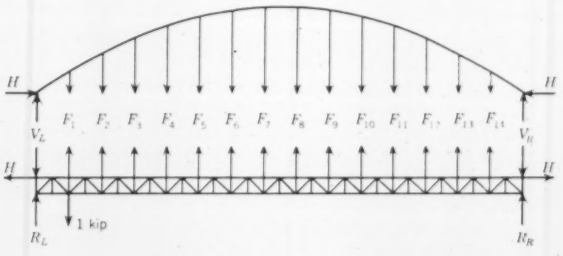


FIG. 2. Fort Pitt Bridge is divided into two free bodies—arch rib and stiffening truss.

Cranes assist in erection of Fort Pitt Bridge in Pittsburgh. Structure of 750 ft span will carry two levels of traffic. Its three main features are two-hinged box girder, stiffening truss, and double deck.

between the ends of the arch rib (Δh_{rib}) must equal the change in length of the stiffening truss (δh_{truss}). That is, for horizontal continuity, $\Delta h_{rib} = \delta h_{truss}$.

It certainly would be a very difficult task to solve the 15 simultaneous equations by using a desk calculator. Actually, with the bridge on a 3-percent grade (causing dissymmetry), the 15 equations must be solved 14 times, one for each position of the unit load, in order to obtain the influence lines of the hanger forces and the thrust. Furthermore, to set up the simultaneous equations, 15^2 or 225 deflection coefficients for the arch rib and 225 deflection coefficients for the stiffening truss are necessary. All this work can be most efficiently carried out by an electronic computer. The computer is an ideal tool to solve simultaneous equations of higher order, matrix inversion, and all repetitious and tedious calculations. Since the computing department of the American Bridge Company is also located in Pittsburgh, their services were engaged.

As the design computations were conducted more than three years ago, an IBM Card Programmed Calculator was used.

The work performed by the computer can be divided into four parts:

1. Geometry. The lengths and slopes of every rib segment and stiffening truss member.

2. Deflection coefficients for arch rib and stiffening truss. The method of elastic weight and conjugate beam was used. These deflection coefficients were combined and formed the constants in the simultaneous equations.

3. Solution of simultaneous equations. They furnished influence lines of hanger forces and rib thrust.

4. Influence-line ordinates of rib moments and influence-line ordinates of axial stress for every stiffening truss member. Very little new programming was required for this part of the work, which is also a tedious task if done without a computer.

The input data to the computer were:

1. Elevations of every rib and truss joint.

2. Distortion area of every member of the structure.

Therefore, beginning with the assumed trial sections and controlling geometrical elevations as input data, the computer furnished all the necessary geometry and influence lines. Then the designer took over. From the values of the influence lines, stresses were checked and with his judgment and experience, new sections were determined. From the new sections, the computer furnished new influence lines. Altogether three trials were conducted. The second and third trials took very little time since all the programming was done.

The computed influence line of hanger No. 5, based on fifteenth degree indeterminacy, is shown by the solid line in Fig. 1. As indicated, it also has a peak at hanger point No. 5 and checks very closely with the experimental results. The peak can be explained by visualizing three different tied arches—A, B, and C as follows:

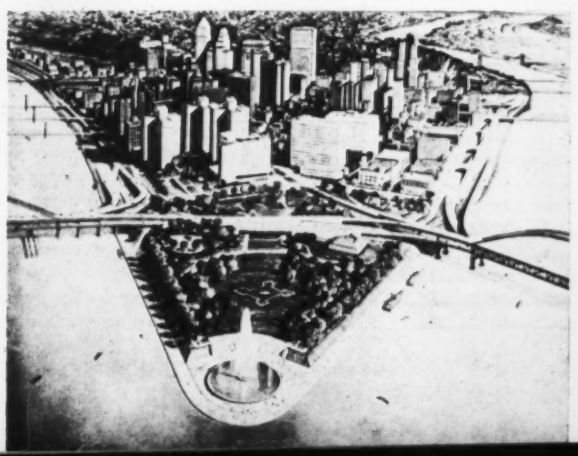
Tied Arch A. Articulated rib with rigid tie. The influence line for the hanger is a smooth curve covering the full span.

Tied Arch B. Rigid rib with articulated tie. The influence line for the hanger is a triangle covering two panel lengths adjacent to the hanger. The hanger stress is caused by localized loads only.

Tied Arch C. Rigid rib with rigid tie. This is the Fort Pitt Bridge. The influence line for the hanger should show the combined characteristics of Tied Arches A and B.

Table I shows the computer typeout of deflection coefficients of the arch rib with unit load at R_6, Fort Pitt Bridge third trial. Moment at various hange

Electronic computers performed vital role in design of two similar, tied-arch bridges near point of Pittsburgh's Golden Triangle. Fort Pitt Bridge is at right across Monongahela River, and Fort Duquesne Bridge, at left, across Allegheny.



A 100-to-1 scale model of Fort Pitt Bridge was used to investigate stress and load relationships. Dead and live loads were represented by lead weights while strain and deflection measurements were recorded.

TABLE I. Deflection coefficients for arch rib, by computer —Fort Pitt Bridge, third trial

FORT PITT BRIDGE – THIRD TRIAL

UNIT LOAD AT 2	49	270260970	DELTA 12 P	49	66441930
LOAD AT 4	49	615509800	DELTA 8 P	49	83039963
LOAD AT 6	50	107570800	DELTA 6 P	49	43361978
LOAD AT 8	50	170137260	DELTA 4 P	49	89819765
LOAD AT 10 P	49	57803580	DELTA 2 P	49	18988887
LOAD AT 8 P	50	20908886	DELTA AT REACTION	49	18988888
LOAD AT 6 P	50	16293927	CHECK UNITY ZERO	49	00000000
LOAD AT 4 P	50	11982809			
LOAD AT 2 P	49	63776502			
RIGHT REACTION	49	30981088			
01 LEFT REACT	49	44448188			
DELTA 2	49	82882984			
DELTA 4	49	69761878			
DELTA 6	49	89974847			
DELTA 8	49	78878847			
DELTA 10	49	89841699			
DELTA 12	49	84868789			
DELTA 14	49	84739939			
DELTA 14 P	49	81888113			
DELTA 12 P	49	83466877			

TABLE II. Influence-line ordinates of top chord No. 8-9, by computer —Fort Pitt Bridge, third trial

TOP CHORD 8 9
INFLUENCE LINE ORDINATES

UNIT LOAD AT L2	49	270260970
UNIT LOAD AT L4	49	615509800
UNIT LOAD AT L6	50	107570800
UNIT LOAD AT L8	50	170137260
UNIT LOAD AT L10	49	57803580
UNIT LOAD AT L12	49	35757947
UNIT LOAD AT L14	50	10963714
UNIT LOAD AT L14P	50	16164618
UNIT LOAD AT L12P	50	19140650
UNIT LOAD AT L10P	50	20908886
UNIT LOAD AT L8P	50	18988120
UNIT LOAD AT L6P	50	16293927
UNIT LOAD AT L4P	50	11982809
UNIT LOAD AT L2P	49	63776502
SUM POS ORDINATES	51	12349617
SUM NEG ORDINATES	50	42408866
ALGEBRAIC SUM	50	81087300

TABLE III. Computed geometry of stiffening truss, by computer—Fort Duquesne Bridge

FORT PANEL POINT NO.	DUQUESNE TOP CHORD LENGTH	TRUSS CHORD TANGENT	GEOMETRY BOTTOM CHORD LENGTH	BOTTOM CHORD TANGENT	DIAG LENGTH	DIAG TANGENT
	23.5002	.00387234-	23.5002	.00387234-	33.1697	.99614765
.0001	23.5002	.00386808-	23.5002	.00386808-	33.2984	1.00386808-
.0002	23.5008	.00812340-	23.5008	.00812340-	33.0993	.99187659
.0003	23.5008	.00811914-	23.5008	.00811914-	33.3692	1.00811914-
.0004	23.5018	.01237446-	23.5018	.01237446-	33.0290	.98764553
.0005	23.5018	.01237021-	23.5018	.01237021-	33.4402	1.01237021-
.0006	23.5032	.01662127-	23.5032	.01662127-	32.9590	.98337872
.0007	23.5032	.01662127-	23.5032	.01662127-	33.5114	1.01662127-
.0008	23.5051	.02087234-	23.5051	.02087234-	32.8890	.97912765
.0009	23.5051	.02087234-	23.5051	.02087234-	33.5826	1.02087234-
.0010	23.5074	.02512340-	23.5074	.02512340-	32.8192	.97487659
.0011	23.5074	.02512340-	23.5074	.02512340-	33.6541	1.02512340-
.0012	23.5101	.02937446-	23.5101	.02937446-	32.7495	.97062553
.0013	23.5101	.02937021-	23.5101	.02937021-	33.7256	1.02937021-
.0014	23.5133	.03362553-	23.5133	.03362553-	32.6800	.96637446
.0015	23.5133	.03362553-	23.5133	.03362553-	33.7974	1.03362553-
.0016	23.5169	.03787659-	23.5169	.03787659-	32.6107	.96212340
.0017	23.5168	.03787234-	23.5168	.03787234-	33.8692	1.03787234-

TABLE IV. Stiffening-truss stresses for unit load, by computer—Fort Duquesne Bridge

FORT PANEL POINT NO.	DUQUESNE TOP CHORD	TRUSS BOTT.CHORD	UNIT LOAD AT P.P. 10 STRESSES DIAGONAL	VERTICAL
		444.4482	627.3229-	
.0001	888.8964-	444.4482	629.7569	.0019-
.0002	888.9191-	1333.3786	625.9914-	3.7825
.0003	1777.8381-	1333.3786	631.0959	.0057-
.0004	1777.9138-	2222.3922	624.6619-	7.5650
.0005	2666.8707-	2222.3922	632.4387	.0095-
.0006	2667.0295-	3111.5344	623.3380-	11.3362
.0007	3556.0394-	3111.5344	633.7853	
.0008	3556.3268-	4000.8677	622.0141-	15.1149
.0009	4445.4085-	4000.8677	635.1319	
.0010	4445.8435-	4890.1130	775.8677	18.8936
.0011	5334.3824-	4890.1130	795.6053-	
.0012	5334.7654-	2778.9710	774.2199	14.1702
.0013	2223.1767-	2778.9710	797.2956-	.0118-
.0014	2223.4793-	1667.6093	772.5769	9.4563
.0015	1111.7392-	1667.6093	798.9930-	
.0016	1111.9095-	555.9543	770.9386	4.7234
.0017	.0008	555.9520	800.6904-	.0024-
.0018				
CHK MOMENT	.01880000	VERT SHEAR	.0001	HORZ SHEAR

TABLE V. Unit-stress influence line of arch rib, by computer—Fort Duquesne Bridge

FORT	DUQUESNE	ARCH RIB	UNIT STRESS INFLUENCE LINE		PAGE 12		
SEGMENT #	ML/S	MR/S	P/A&ML/S	P/A-ML/S	P/A&MR/S	P/A-MR/S	Load
3.0000	.7217	.1133	1.8623	.4189	1.2839	1.0273	1
3.0000	3.3690	.6785	5.4632	1.2748-	2.7739	1.9159	2
3.0000	.4711	3.0548	3.2949	2.3827	5.8786	.2310-	3
3.0000	.5184-	.4393	2.6583	3.6951	3.6160	2.1374	4
3.0000	.9061-	.5175-	2.2671	4.2793	2.6587	3.4907	5
3.0000	1.0368-	.7779-	1.7725	3.8461	2.0314	3.8673	6
3.0000	.9000-	.7501-	1.2131	3.0131	1.3630	2.8632	7
3.0000	.5272-	.4672-	.6183	1.6727	.6783	1.6127	8
3.0000							
3.0000	4.5618	4.2842	19.1497	19.9779	20.2699	16.9339	T+
3.0000	3.8883-	2.5127-		1.2748-		.2310-	T-
3.0000	.6733	1.7715	19.1497	17.8031	20.2699	16.7029	Net

points due to unit load is at the left. Then under conjugate beam, load at various points, or the elastic weights, are listed. The deflection coefficients are shown as deltas. The computation was done in floating point.

Table II gives the influence-line ordinates of Top Chord 8–9, also of the Fort Pitt Bridge, third trial. The loading positions and the respective influence ordinates are typed in two columns. The asterisk in this case represents a negative sign. The sum of positive ordinates, the sum of negative ordinates, and the algebraic sum are also neatly typed out at the bottom.

Fort Duquesne Bridge design

The design of the Fort Duquesne Bridge is very similar to that of the Fort Pitt Bridge with the exception that the Fort Duquesne has a shorter span, of 423 ft, has only eight hangers, and therefore is statically indeterminate to the ninth degree. The services of the computing department of the American Bridge Company were also engaged for this bridge. This time, however, an IBM 650 was used. Since much of the work was done in the same way as it was for the Fort Pitt Bridge, three of the output sheets for the Fort Duquesne Bridge are shown here as Tables III, IV and V.

Table III is the computed geometry of the Fort Duquesne Bridge stiffening truss. Lengths and tangent of slopes of top chord, bottom chord, and diagonal members are summarized. The left-hand column gives the panel-point numbers which identify the members.

Table IV shows stresses in the Fort Duquesne Bridge stiffening truss due

to unit load at panel point No. 10. The stresses are used in the virtual-work solution of deflection coefficients. The five columns are panel-point numbers, top-chord stress, bottom-chord stress, diagonal stress, and vertical stress. The bottom line shows the check moment and shear, both practically zero.

Table V is the unit-stress influence line of the arch rib, Fort Duquesne Bridge. Column 1 gives the segment number, which is 3; Col. 2, moment at left end of segment divided by the section modulus; Col. 3, moment at the right end of segment divided by the section modulus; Cols. 4, 5, 6, and 7 give the four possible combinations of fiber stress—$P/A \pm M/S$ of left and right ends of the segment. The first line of the typeout is due to the load at panel point No. 1; the second line is due to the load at panel point No. 2, and so on. Again the sum of positive ordinates, negative ordinates, and the algebraic sum are neatly typed out at the end of the sheet.

In conclusion, two points could be emphasized. First, there is the significance of using electronic computers in the design of the arch bridge. This of course meant a large time saving for the designers as they did not have to do the tedious and repetitious calculations. This in turn raised the engineers' morale and produced better engineers for they had more time to exercise their engineering judgment and could afford to make more design trials. But there was also the exactness of the solution, which could not have been achieved without the use of the computer. The computer enabled us to find agreement between experimental and theoretical results. (Attempts were made at first to solve the 15 simultaneous equations by hand by relaxation techniques. This was unsuccessful because the equations proved to be too sensitive.)

The second point is the division of work between men and computer. In general, the design of indeterminate structures can be represented by a simple flow diagram that has two black boxes. The first box represents the choice of sections or, in succeeding trials, the determination of the best new sections. The second box is analysis, which generally involves lengthy and tedious calculations. The two boxes are hooked up in a loop. Because the first box calls for sound engineering judgment, which can be effectively and readily carried out by experienced engineers, the computer was used only as the second box. The proper division of work between man and computer is very important since the available programming time is limited.

Our experience in the use of electronic computers has been most satisfactory. We now have had a Bendix G-15 D computer for over a year. It is used exclusively by our office for highway, structural, and hydraulic computations. Through the combined efforts of the Bendix Users, over eighty programs in the field of civil engineering are now available.

ENGINEERS' NOTEBOOK

Simplified deflection calculations by virtual work

ELWOOD HEINZ, J.M. ASCE, Structural Designer, The M. W. Kellogg Co., New York, N. Y.

Calculations for the deflection of beams or rigid frames by the method of virtual work involve evaluation of the term $\Sigma \int M\, m \frac{ds}{E\,I}$ over the entire member. In this term, M represents the bending moment at any point due to any system of applied external loads; and m denotes the bending moment at any point due to a unit loading applied in the direction and at the point of the required deflection. The method presented here reduces the work required to evaluate this integral to a series of slide-rule operations.

Consider the member 1-2 (Fig. 1) with the applied moments M_1 and M_2 varying linearly along its length. The moments at any point can be expressed as

$$M_x = M_1 + \left(\frac{M_2 - M_1}{L}\right) x \qquad (1)$$

Similarly,

$$m_x = m_1 + \left(\frac{m_2 - m_1}{L}\right) x \qquad (2)$$

Then

$$\int_0^L M\, m \frac{ds}{E\,I} = \int_0^L \left[M_1 + \left(\frac{M_2 - M_1}{L}\right) x\right] \left[m_1 + \left(\frac{m_2 - m_1}{L}\right) x\right] \frac{ds}{E\,I} \qquad (3)$$

Expanding and integrating yields the basic equation,

$$\int_0^L M\, m \frac{ds}{E\,I} = \frac{L}{3\,E\,I}\left(M_2 m_2 + M_1 m_1 + \frac{M_1 m_2}{2} + \frac{M_2 m_1}{2}\right) \qquad (4)$$

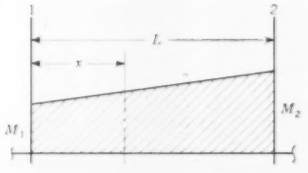


FIG. 1. Moment diagram for derivation of basic equation.

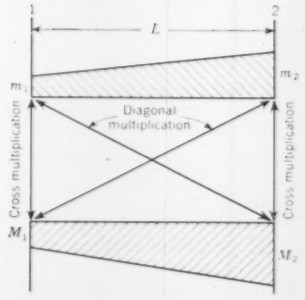


FIG. 2. Arithmetical procedure for solving basic equation.

The term L represents the distance between any two points on the structure between which the moments have a unique constant variation. This means that points 1 and 2 must be either a joint or a point at which a concentrated load is applied.

If the moment diagrams for M and m are placed one above the other, the solution of Eq. 4 can be performed arithmetically by two distinct types of operation—cross multiplication and diagonal multiplication. See Fig. 2. The results of the diagonal multiplication must be multiplied by one-half. The sum of these operations is then multiplied by the term $\frac{L}{3EI}$. Applying this operation to all lengths, L, of a structure and summing up will then give the required deflection.

A further simplification of the above steps can be made by first multiplying each value of m by its relative $\frac{L}{I}$ term. The cross and diagonal multiplication can then be applied to the sum of two applicable m values.

Illustrative problem

Find the horizontal deflection at point 2 of the frame (Fig. 3) from the given moment diagrams for M and m. The actual process of cross and diagonal multiplication is shown in Fig. 4, where the first few steps are lettered to illustrate the procedure. Actually, each step can be performed directly on the slide-rule and only the results need to be recorded. The sign convention for the M and m moments has to be consistent. In this case tension on the inner fibers of the frame was considered positive. The positive answer indicates that the deflection is in the same direction as the applied unit load.

The problem of calculating the deflection at the point of, and in the direction of, an applied unit load can be considered as a special case of Eq. 4. For this condition, $M = m$. Then Eq. 4 becomes

$$\int_0^L m^2 \frac{ds}{EI} = \frac{L}{3EI}(m_1^2 + m_2^2 + m_1 m_2) \qquad (5)$$

The application of this equation is evident from the previous discussion.

The basic equation was derived from moments caused solely by direct loads and therefore is not applicable for any applied uniform loading. That portion of the structure acted upon by uniform loads would have to be evaluated in the usual manner. The method presented here could then be performed on the remaining portion of the structure.

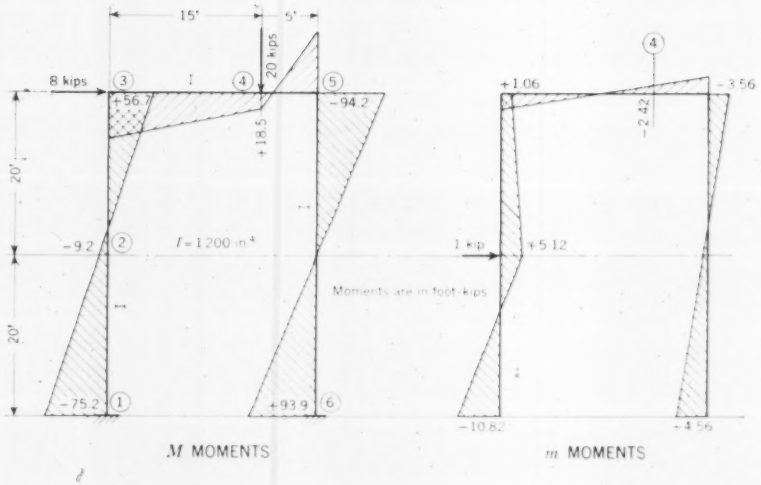


FIG. 3. Given moments m and M for illustrative problem.

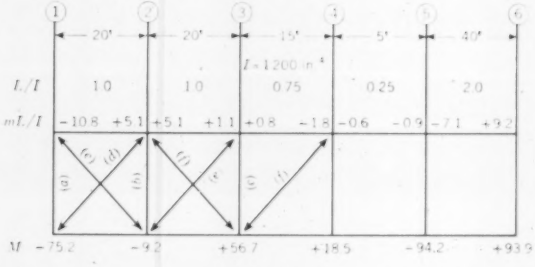


FIG. 4. Step-by-step solution of illustrative problem.

Cross Multiplication			Diagonal Multiplication		
(a)	$-75.2 \times -10.8 =$	813	(d)	$-75.2 \times 5.1 =$	-383
(b)	$-9.2 \times (5.1 + 5.1) =$	-94	(e)	$-9.2 \times (-10.8 + 1.1) =$	89
(c)	$56.7 \times (1.1 + 0.8) =$	108	(f)	$56.7 \times (5.1 - 1.8) =$	187
	$18.5 \times -2.4 =$	-45		$18.5 \times -0.1 =$	-2
	$-94.2 \times -8.0 =$	754		$-94.2 \times 8.6 =$	-810
	$93.9 \times 9.2 =$	864		$93.9 \times -7.1 =$	-665
		2,400			$-1,584$
				$\frac{-1,584}{2} =$	-792

The algebraic summation of the cross multiplication and the diagonal multiplication is 1,608. Therefore

$$EI\delta = 1{,}608 \frac{L}{3} = 1{,}608 \times \frac{20}{3} = 10{,}720.\ I = 1{,}200\ \text{in.}^4,\ E = 30 \times 10^3\ \text{ksi},$$

and a factor of 1,728 is required to yield an answer expressed in inches. Then

$$\delta = \frac{10{,}720 \times 1{,}728}{30 \times 10^3 \times 1{,}200} = 0.515\ \text{in.}$$

Controlled-porosity pipe dewaters dune sand

FLORENT H. BAILLY, A.M. ASCE, Bailly Engineering Enterprises, Pasadena, Calif.

Concrete pipe made to a controlled permeability has been used successfully to extract fresh water from sand dunes at Coos Bay, Oregon. A gallery 200 ft long consisting of pipe with an inside diameter of 36 in. was installed as a pilot plant to produce industrial water for the Pacific Power and Light Co.

This porous pipe was developed from experiments in cementing oil wells. It was found that a certain mixture of portland cement, with an activated silica-replacement material and a controlled water content, in a definite volume ratio to aggregates of fixed size and shape, will provide a structurally strong concrete with a predetermined porosity and permeability as well as efficiency in screening out minute particles. The activated silica is in the form of calcined oil-impregnated shales and fly ash.

The equivalent of the pore volume in the concrete can be added to the batch as a non-aqueous but liquid vehicle to facilitate mixing and placing. After a normal curing period, the liquid will drain out or can be flushed out. It can be reused if it can be recovered. Under most conditions the carrier liquid will not interfere with normal steam or other heat curing.

Engineering and geologic studies in the dune area at Coos Bay indicated that one method of extracting fresh water from the dunes—replenished by rainfall and underwater sources—was to build and pump a collecting gallery for more than one seasonal cycle.

Newly developed permeable concrete pipe can be designed to screen out solids in a certain range of particle size, without inhibiting the passage of fluids. This pipe has 36-in. inside diameter.

Texture of permeable concrete pipe is such that pipe walls do not allow any sand to pass through. At same time, there is no decrease in amount of water extracted. Aggregates can be varied.

Sand is very fine

Analysis of the dune material showed a remarkable uniformity throughout the area, 98 percent of the material being between the 80- and 100-mesh range and the remaining 2 percent up to 150 mesh. The permeability of the concrete in the pipe was made of the order of 2,000 Darcies liquid, or 40,000 gal per day in Meinzer units, that is, in gallons per day per square foot of face per foot of length per foot of head pressure gradient.

The elongated shape of the aggregate used provided a texture that appeared as a multitude of minute slits. It has been found that a departure from sphericity in the aggregate controls the screening efficiency of the permeable concrete. As a natural corollary, the departure from sphericity also controls any tendency to plugging.

Construction was simple

An excavation was made to 5 ft below low tide and about 18 ft below the water table. Three 8-ft sections of the 36-in. pipe were clamped together, with heavy canvas strips at the joints to form 24-ft segments for placing. The 24-ft segments in turn were clamped together by a diver below water. The gallery was sealed at one end, and the other end was closed by a vertical caisson of 8-ft diameter with its top flush with the surface, where a pump was installed. The entire gallery was backfilled with the excavated sand and the surface restored to its original level.

As installed, the pipe walls of permeable concrete are effectively screening out the dune sand. Some of the canvas joints failed with time and permitted sand to enter the pipe but the pipe walls themselves did not allow any passage of sand. There was no decrease in the amount of water extracted due to sand plugging. These facts were determined after 16 months of operation, when the installation was inspected by a diver who entered the gallery via the caisson.

The strength of the concrete, with a 30-percent pore space, was dependent upon the kind and shape of the aggregate used. In repeated tests, cement with an activated silica additive performed from 50 percent to 300 percent better in bonding and in compression than portland cement when used alone. Portland cement alone is not satisfactory for this use. It cannot be used for a designed porosity and permeability in concrete because it lacks surface tension, which is present in the modified cement.

Many applications are being found for permeable concrete. The one here described illustrates a pioneering use for this new material. The gallery described, for extraction of water from unconsolidated fine sands, could not have been successful without it.

Further information is available from the writer, at 709-711 South Fair Oaks Avenue, Pasadena, Calif.

Traverse closure as a mathematical method

JOHN F. TANNER, J.M. ASCE, Vice President, Sholders & Tanner Engineering, Inc., Escondido, Calif.

Last semester, as a part-time instructor in dynamics, in the Engineering Department at San Diego State College, Calif., I encountered a problem of relative position in plane motion. The machine in the problem consisted of a series of interconnected linkages having plane motion. Enough information was given to ascertain directly the angular position and length of all but two of the members of the system.

Direct information was available for the angular position of one member and the length of the other, but it was necessary to solve indirectly for the remaining length and angular position. Some of the students in the class thought the solution impossible while others tried vainly for several hours to find a system of triangles and rectangles that would afford a trigonometric solution.

I had been doing a good deal of subdivision work, involving the closing of many traverses, and it was by this method I was able to arrive at the solution here offered, in a matter of minutes.

This illustration is cited in the belief that many engineers erringly limit the use of traverses to land surveying problems. In many engineering problems a mathematical solution for unknown distances or angles can be found more efficiently by effecting a traverse closure than by constructing a network of triangles and rectangles.

At that time I was unable to give the students any reference material on the "criss-cross" method of traverse closure, as it is often called. Since that time I have found that many universities offer no instruction in this method and that most surveying texts and engineering handbooks make no reference to it. It has proved such a time saver to me that I wish to outline it briefly here.

Any one of four cases can arise in the closing of a traverse:

1. One closing side with an unknown bearing and an unknown distance
2. Two closing sides with two unknown distances
3. Two closing sides with an unknown distance and an unknown bearing
4. Two closing sides with two unknown bearings

Case 3 is the one under discussion here.

Solution in eleven steps

The problem is to find the distance of one closing side and the bearing of the other. Proceed by the following steps:

1. Find the algebraic excess in departures and latitudes, where

East is plus	North is plus
West is minus	South is minus

2. Give the sines and cosines of the bearings of the closing sides algebraic signs as follows:

A sine that gives an east departure is plus.

A sine that gives a west departure is minus.

A cosine that gives a north latitude is plus.

A cosine that gives a south latitude is minus.

3. Multiply the excess departure by the cosine of the known bearing of one of the closing sides.

4. Multiply the excess latitude by the sine of the bearing of that closing side.

5. Subtract the two products from each other.

6. Divide the difference by the known distance of the other closing side. This is the sine of the angle between the closing sides.

7. Using Step 6, find the bearing of the other closing side.

8. Multiply the excess departure by the cosine of the bearing of the closing side found in Step 7.

9. Multiply the excess latitude by the sine of the bearing of that closing side.

10. Subtract the two products from each other.

11. Divide the difference by the sine of the angle between the bearings of the closing sides (Step 6) for the unknown distance of the other closing side.

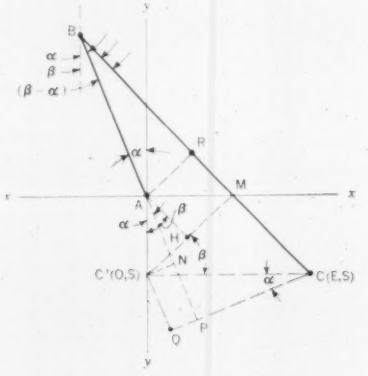


Fig. 1. Coordinates *E* and *S* represent excess easting and southing of traverse to be closed by line *AB*, having a known bearing (alpha), and line *BC*, having a known length. Find length of line *AB* and bearing of line *BC* (beta).

Derivation of method

The derivation of this method is shown in Fig. 1.

Let the coordinates E and S represent the excess departure (easting) and the excess latitude (southing) of a traverse to be closed by line AB having a known bearing α, and line BC having a known length. Find the length of line AB and the bearing, β, of line BC.

Extend line BA to point P so that line PC is perpendicular to line PAB. Therefore the angle $C'CP = \alpha$.

Extend line CP to Q so that line $C'Q$ is perpendicular to line CQ. Therefore $C'C$ (cos α), or $E \cos \alpha = QC$.

Draw line $C'N$ perpendicular to line BAP. Therefore AC' (sin α) or S (sin α) $= C'N = QP$.

$$QC - QP = PC = BC \sin (\beta - \alpha)$$

$$\text{Therefore } \sin (\beta - \alpha) = \frac{QC - QP}{BC} =$$

$$\frac{E \cos \alpha - S \sin \alpha}{BC}$$

Draw line $C'M$ perpendicular to line BC. Therefore the angle $CC'M = \beta$. Therefore $C'C$ (cos β) $= C'M$, or $E \cos \beta = C'M$.

Draw line AH parallel to line BMC. Therefore the angle $C'AH = \beta$. Therefore $AC' \times \sin \beta = C'H$ or $S \sin \beta = C'H$.

Draw line AR perpendicular to line BMC. Therefore $C'M - C'H = HM = AR = AB \sin (\beta - \alpha)$. Or

$$AB \sin (\beta - \alpha) = E \cos \beta - S \sin \beta$$

$$\text{Or } AB = \frac{E \cos \beta - S \sin \beta}{\sin (\beta - \alpha)}$$

THE READERS WRITE

More about Sequent depth in hydraulic jump

To the Editor: In the July 1958 issue (p. 66), Professor Sarpkaya presented an article entitled "Computation of Sequent Depth in Hydraulic Jump Simplified." In this article it was required to solve the following relationship for d_1:

$$d_2 = -\frac{d_1}{2} \pm \sqrt{\frac{2q^2}{g\,d_1} + \frac{d_1^2}{4}} \quad \ldots \ldots \quad (1)$$

This can be solved for d_1 in terms of d_2 and q. Transposing, squaring both sides, and collecting terms, we get

$$d_1^2 + d_2 d_1 - \frac{2q^2}{d_2} = 0 \quad \ldots \ldots \quad (2)$$

Solving this by the quadratic formula,

$$d_1 = -\frac{d_2}{2} \pm \sqrt{\frac{2q^2}{g\,d_2} + \frac{d_2^2}{4}} \quad \ldots \ldots \quad (3)$$

which shows that the equation can be used to solve for either unknown by simply interchanging subscripts.

Joseph B. Bohac, J.M.ASCE
Horner & Shifrin

St. Louis, Mo.

Author replies

To the Editor: Mr. Bohac seems to have overlooked the statement in the second paragraph of my article which reads, "If either X or Y is known, the other variable could easily be obtained. . . ." This restates the well-known fact that the subscripts can be interchanged in the hydraulic-jump equation. Probably Mr. Bohac's misconception was acquired from the numerical example, which led him to think that in this method it was required to solve for d_1. It is obvious from a careful reading of the article that the method suggested could be used to solve either $X = \frac{d_1}{s}$ or $Y = \frac{d_2}{s}$ without any additional presuppositions or proofs.

It must be added that, because of the interchangeability of the subscripts in the equation, d_1 and d_2 are frequently referred to as conjugate depths, although no jump can take place from d_2 toward d_1. It was for this reason that I referred to it as the "sequent depth" in the hydraulic jump.

Turgut Sarpkaya, A.M.ASCE
Asst. Prof. of Eng. Mechanics
Univ. of Nebraska

Lincoln, Nebr.

Compacted soil vs. asphalt for reservoir lining

To the Editor: The title, "Asphalt Panels for Economical Reservoir Lining," on the article by Louis R. Hovater in the September issue, p. 38, implies that the use of asphalt panels to line a reservoir resulted in an economical sealing job. However, no cost data are given in the article. To put the described method in proper perspective, cost data are needed. Needed also are the costs of materials and labor for installing the panels.

Information on the subgrade is desirable, particularly its thickness, type and cost. The writer's experience has shown that, where proper soils are available, liners of compacted soil can be built at a lower cost than membranes such as that described by Mr. Hovater.

The writer knows of one installation of asphalt lining (not the particular product described by Mr. Hovater) which was entirely unsatisfactory. Even though the waves in this particular reservoir were small, they succeeded in ripping many large holes in the asphalt liner. Also, vegetation grew right through the asphalt even though attempts were made to control such growth by means of chemicals.

T. William Lambe, M.ASCE
Assoc. Prof. and Head, Soil Eng.
Mass. Inst. of Tech.

Cambridge, Mass.

Computing elevations of stilling basin aprons

To the Editor: Reference is made to E. A. Elevatorski's "Direct Solution for Apron Elevation" in the August 1958 issue, p. 60. Your attention is invited to Raymond L. Irwin's discussion (Civil Engineering, June 1942, p. 335) of Clarence Freeman's Engineers' Notebook article, "Nomograph for Computing Elevations of Stilling Basin Aprons" (March 1942, p. 157).

Although Mr. Elevatorski's graph is "dimensionless," the problem can be solved directly with Mr. Irwin's diagram, with no intermediate computation of "dimensionless" parameters. Mr. Irwin's diagram will also yield the depth, velocity, and Froude number for flow at the foot of the spillway.

It appears that Mr. Elevatorski's Eq. 1 should be $V_1 = \sqrt{2g\ (d + h - y_1)}$ for a general solution. It is believed that the velocity head usually would be referred to the surface of the flow rather than to the bottom of the channel. The inclusion of the y_1 term should result in a more accurate general solution.

Ellis B. Pickett, J.M.ASCE
Hydraulic Engineer,
Corps of Engineers

Vicksburg, Miss.

SOCIETY NEWS

1958 Annual Convention—A Great Success

An atmosphere of hope for the future and excitement for today's engineering achievements pervaded this year's Annual Convention, held at the Statler-Hilton in New York, October 13-17. The stimulating program, technical and social, offered far more than any one person could begin to assimilate. There were, for example, 41 technical sessions, including eight programs with the International Association for Bridge and Stuctural Engineering; more than 50 committee meetings; a succession of distinguished speakers, including a United States Senator and the new superintendent of the New York City school system, who happens to be a civil engineer; the annual presentation of Society prizes and honors; induction of new officers; Conditions of Practice sessions devoted to the vital subject of engineering education; and tours of some of the big construction projects in the metropolitan area.

Contributing to the hopeful atmosphere of the Convention was the large number of young engineers and students represented in the attendance of 2,550. The attendance at the Student Chapter Conference on Monday afternoon included students from schools as far afield as the University of Wisconsin, as well as an overflow group from the metropolitan area. Another very hopeful aspect was the large attendance of foreign engineers, especially the notable European bridge and structural engineers who took part in eight cooperative programs. There was also a large contingent of ICA engineers from the Argentine at the Conditions of Practice session on engineering education.

Eight Sessions with IABSE

There were overflow crowds for all eight of the half-day joint sessions of the IABSE and the Structural Division. Both European and American engineers had high praise for Leo H. Corning, chairman of the Division's executive committee, for his work in making the cooperative program one of the Convention highlights. Practically the entire range of structural engineering developments on two hemispheres came in for discussion at the joint sessions. Advances in structural design, research in the behavior of structures and properties of materials, and construction techniques were covered. Many of the papers will be published later in the Journals of the Divisions. Though the program was sponsored and coordinated by the Structural Division, the Construction and Engineering Mechanics Divisions also participated.

The joint program culminated in an International Engineering Luncheon, with the flags of all nations flying. Gail Hathaway, Past-President of ASCE and consultant to the International Bank for Reconstruction and Development, was featured speaker. In his illuminating talk, entitled "Economic Aspects of International Engineering Projects," Mr. Hathaway discussed the organization of the World Bank, the agency that finances projects in the underdeveloped areas of the world. Mr. Hathaway emphasized the fact that World Bank loans are, indeed, loans and not gifts, as is commonly supposed. Actually, he said, the World Bank was set up as an agency "for international investment to increase production, raise living standards, and help bring about a better balance in world trade." The 68 member countries of the Bank are its stockholders, each subscribing to its capital stock in accordance with its economic strength.

Dr. Theobald Luncheon Speaker

The strong program on engineering education must have inspired more confidence in what our schools and colleges are trying to do than any similar program since Russian Sputniks first gave us cause for serious concern about our brand of education. The program began with the featured talk at the Wednesday luncheon—given by John J. Theobald, M. ASCE, new superintendent of the New York City Public School System—and continued through the Wednesday afternoon session conducted by the Department of Conditions of Practice. In introducing Dr. Theobald, Vice-President Waldo Bowman expressed the pride of the Society in the appointment of one of its members to head the largest educational system in the world and called this recognition of a civil engineer "a heartening sign." Dr. Theobald, whose

Walter E. Jessup, editor of "Civil Engineering," receives Scroll of Appreciation for nearly thirty years of service to the Society. The presentation was made by Executive Secretary W. H. Wisely in behalf of the Board of Direction. New ASCE President Francis S. Friel is seated at left.

degrees are in civil engineering rather than education, is a former professor of civil engineering at the College of the City of New York. For the past two years he has been deputy mayor of New York.

In his constructive and inspiring talk, entitled "Journey to Knowledge," Dr. Theobald traced the growth of free education in the United States from the inception of the nation and showed how education has improved since the "good old days" when education (mainly the three R's) was for the few. Today we have the obligation to educate all, each according to his ability. Among students in New York's academic high schools, Dr. Theobald said, the vast majority of the boys with I.Q.'s of 115 or above are studying advanced science, and more than half of them are studying advanced mathematics. About 85 percent of these students go on to college.

Dr. Theobald warned against the "excitement and hysteria" following in the wake of Sputnik. "The Russians," he said, "are where we were in 1870 in the sense that only those who can measure up to a certain standard can have an education." The challenge, as he sees it, is "to maintain competition with a nation concentrating on one thing, yet turn out generally educated students, and also educate those of low intelligence for a useful life." Earlier identification of college potential is another essential aim, he believes.

Honorary Memberships Awarded

Three outstanding members of the Society—Henry J. Brunnier, Nathan W. Dougherty, and A M Rawn—were made Honorary Members at the Wednesday Luncheon Meeting. Past-President Mason Lockwood read the citations, and retiring President Louis Howson made the presentations. To give an idea of the august nature of honorary membership in ASCE, Mr. Howson noted that only 175 have attained this distinction in the Society's entire 106 years of existence. Another feature of the Wednesday luncheon was the presentation of a Certificate of Appreciation on behalf of the Society to Convention Chairman Thomas J. Fratar. In thanking Mr. Fratar and his hard-working committees, the Society's new President Francis Friel remarked that "literally years of work go into making a Convention a success."

Conditions of Practice Session

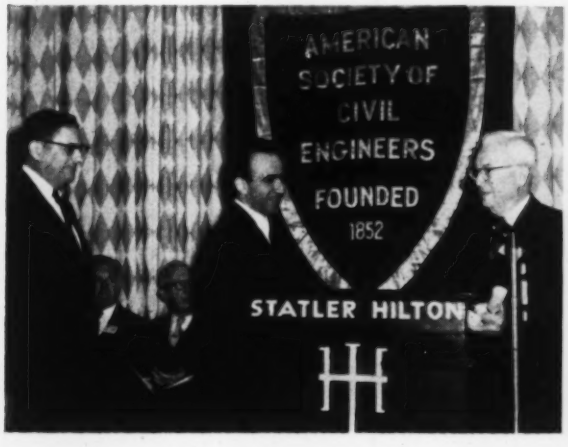
Four well-known civil engineering teachers were the speakers at the Conditions of Practice session on engineering education. In the lead-off talk on where the emphasis should be placed, Dean Linton E. Grinter, M. ASCE, of the University of Florida Graduate School, deplored the small amount of basic engineering science studied in civil engineering courses and said that too much of what is taught is not transferrable to other fields. He spoke of the "high transfer value" of English and mathematics, and urged that science be brought into the teaching of civil engineering. "We have not bred scholarship in the civil engineering curriculum," he said.

J. B. Wilbur, M. ASCE, professor of civil engineering at Massachusetts Institute of Technology, stressed the importance of balance in engineering education. There must be an optimum balance between the science and the art of civil engineering, he said. Approving one does not mean disapproving of the other. "Most of tomorrow's engineering will still be done on earth and still will involve work with people," which means more attention to the humanities. He concluded that, "Human know-what may be more challenging than technical know-how."

Policies and procedures pursued by Engineers Council for Professional Development in its accreditation work were explained in a helpful talk by F. C. Lindvall, professor of electrical and mechanical engineering at California Institute of Technology and chairman of the ECPD Education and Accreditation Committee. Accreditation has a twofold purpose, he said. It helps provide a mechanism for the faculty, and helps the school to weed out its weak spots and strengthen its curriculum. Professor Lindvall asked for more practicing engineers to help with ECPD's accreditation work instead of leaving it entirely to the professors.

Though the final talk on the program —given by Mario G. Salvadori, M. ASCE, professor of civil engineering at Columbia University—was entitled "Mankind Faces a Technological Culture." Dr. Salvadori also stressed the good general background. Warning that "synthetic thought is the basis of barbarism," he told his fellow educators that "forming good minds" is one of their prime responsibilities. He advocates a few fundamental formative courses, with strong emphasis on English and mathematics. Like Dr. Theobald, he recognizes the right of all to participate in the learning process—a giant step forward from the time, only a few decades ago, when "only one person in 10,000 counted."

Nathan M. Newmark (left in left-hand view) and Anestis S. Veletsos, both of University of Illinois faculty, shared the Norman Medal, which is being presented to them by retiring President Louis Howson. In photo at right Gail Hathaway, Past-President of ASCE and consultant to the International Bank for Reconstruction and Development, addresses the International Engineering Luncheon. Seated are John I. Parcel, Honorary Member of ASCE and vice-president of the International Association for Bridge and Structural Engineering, and IABSE President Fritz Stussi, of Switzerland.



At Consultants' Dinner, another feature of Convention week, Herschel H. Allen (left), president of American Institute of Consulting Engineers, presents Award of Merit to James R. Killian, Special Assistant to the President, for Science and Technology.

Reclassification of Member Grades Discussed

The proposed reclassification of member grades was discussed at some length at the Society's annual business meeting on Wednesday morning. Dissatisfaction with the proposed top grade of "Fellow" was expressed by several members. A motion was made that the membership of ASCE be circularized by postal card and asked to make a choice between "Fellow" and "Senior Member" for the top grade before the reclassification proposal goes out for letter ballot. The motion was voted down. A motion to table the amendment was met with a nearly unanimous "No." The reclassification proposal will go to the membership for ballot on November 21 in the form approved by the Board of Direction (July 1957, page 81; September 1958, page 33). The balloting will close on January 23. The votes will be counted on January 26, and the tellers will report to the Board in Los Angeles on February 9.

The traditional presentation of prizes for papers in Transactions was another feature of the Wednesday morning meeting. All but two of the seventeen prize winners attended the ceremony. The others are abroad and will receive their prizes at a later Society function. Walter E. Jessup, who will retire next month as editor of CIVIL ENGINEERING, was surprised by a special scroll of appreciation for his thirty years of service to the Society. Executive Secretary William H. Wisely made the presentation to Mr. Jessup on behalf of the Board of Direction.

At the close of the Wednesday morning program Francis S. Friel, Philadelphia consultant, took office as the 90th President of the Society. The obligation and responsibility of every member to the Society and the Society's role in the growth of the country were discussed by Mr. Friel in his thought-provoking inaugural address. His address is printed in this issue. Taking office, also, are new Vice Presidents for Zones II and III, Paul L. Holland and Lloyd D. Knapp, and seven new Directors. The Directors are Thomas J. Fratar, District 1; Earl F. O'Brien, District 3; Daniel B. Ventres, District 5; Charles W. Britzius, District 7; Wayne G. O'Harra, District 11; Fred H. Rhodes, Jr., District 12; and N. T. Veatch, District 16.

Student Chapter Conference

"Professionalism for Engineers" was the topic of the Metropolitan Conference of Student Chapters, which drew hundreds of students from the New York area plus groups that had come on their own from all over the Eastern Seaboard. The Metropolitan Conference of Chapters has been expanded to include Stevens Institute of Technology, bringing to nine the number of member Chapters. Charters for all nine Chapters were presented to representatives of each group.

The featured speakers were Enoch R. Needles, Past-President of ASCE and consulting engineer of New York City; Martin S. Kapp, J.M. ASCE, soils and foundations engineer for the Port of New York Authority; and Milton Alpern, J.M. ASCE, consulting engineer and assistant professor of civil engineering at Cooper Union. All see a strong ASCE as a prerequisite to professionalism. Mr. Needles said that the change from nonprofessional to professional must be gradual. The truly professional man will have education, training, experience, absolute integrity, and a strong sense of personal service. Mr. Kapp suggested that the shortage of engineers is "nonsense" and that the proper use of technicians and computing machines will "reserve engineers for the important work." Mr. Alpern suggested practical ways of improving professional status. Concentrated technical reading and research were suggested as something each engineer can do to improve his status. "We must be watchdogs over the whole subject of engineering education," he said.

At the conclusion of the panel there was enthusiastic discussion from the

Student Chapter at Manhattan College takes occasion during the Convention (photo at left) to present its check for $100 for the new United Engineering Center Building to David G. Baillie, chairman of the Metropolitan Section's Fund Raising Committee. Shown, in usual order, are Anthony Spinella, vice-president; Frederick Richards, secretary; Mr. Baillie; Robert Albertelli, treasurer; and William McElligott, president. ASCE Past President Carlton S. Proctor (left in photo at right) introduces Karl Terzaghi, Hon. M. ASCE, at Society luncheon in Dr. Terzaghi's honor on the occasion of his 75th birthday. Toastmaster Arthur Casagrande is at right with new ASCE President Francis Friel.

floor. The young men asked some very searching questions: Can we be truly professional if we don't have the literature, the philosophy, the social courses that the other professions have to study? What about unionization? How can we make all engineers (not just 40 percent) join the Society?

City Planning Luncheon

The City Planning Division observed its thirty-fifth anniversary at the Urban Renewal Luncheon. The guest speaker, the Hon. Prescott Bush, United States Senator from Connecticut and member of the Senate Subcommittee on Housing, deplored the defeat of the Urban Renewal Law in the last Congress, calling it a "set-back to eliminating urban blight." He said that the plan, one of the most vital and useful in the United States, failed because of its enormous cost in a year when there was a huge budget deficit. It is his belief that urban renewal would gradually pay for itself, as increased tax revenues must ultimately follow slum clearance. Senator Bush said that his experience in his own state convinces him of the soundness of the program, and he urged his engineer hearers to bring about a better understanding of the need for urban renewal in their communities.

Dr. Terzaghi Honored

Dr. Karl Terzaghi, Hon. M. ASCE, and professor emeritus of civil engineering at Harvard, was honored by the Soil Mechanics and Foundations Division at a general luncheon of the Society on the occasion of his 75th birthday. Introducing Dr. Terzaghi, Carlton Proctor, Past President ASCE, quoted his late partner Dan Moran of Moran, Proctor, Mueser & Rutledge as predicting in the early 1920's that "Karl Terzaghi was the long-awaited genius destined to establish the basis for a scientific approach to the mechanics of soils, to equip the professional practice of foundation engineering, for the first time, with professional tools and thus to provide scientific status to an empirical technology."

Responding on the subject "Soil Mechanics in Action," Mr. Terzaghi stated that soils engineering requires years of study, experience, and practice. Soils mechanics is a guide for judgment, not a substitute; and the judgment can come only from years of experience close to the actual work in the field. Young graduates in soils mechanics are expected by many to be experts but they are far from it. The road to that status is long and strenuous and is not necessarily followed by success. Effort alone is not enough. It requires innate qualifications over which the individual has no control.

Dr. John Theobald, civil engineer, superintendent of New York City schools, and until recently deputy mayor of New York, addresses the Awards Luncheon. At left are President and Mrs. Francis Friel and Thomas J. Fratar, general chairman of the New York Convention Committee.

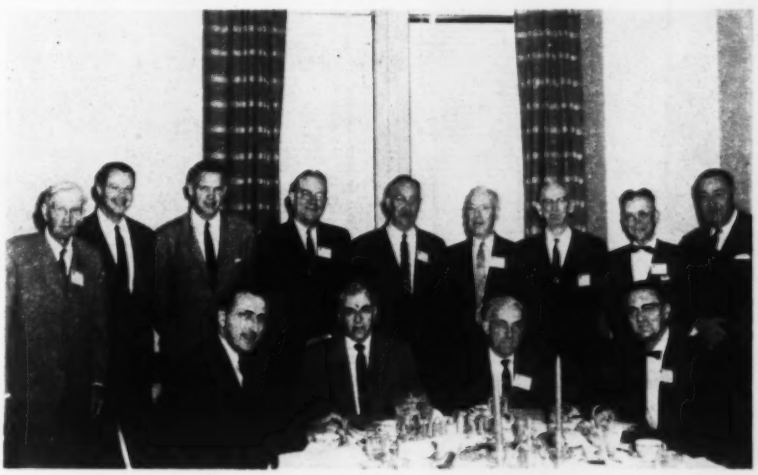
Prof. Arthur Casagrande, M. ASCE, announced that the writings of Dr. Terzaghi are being collected by his friends into a monumental compilation that will honor this founder and developer of the art and science of soil mechanics and at the same time be a work of very great usefulness to the profession. Mr. Casagrande also stated that an endowment is being developed to establish an award in Mr. Terzaghi's honor.

Civil Engineering Show

The Civil Engineering Show of equipment and materials was a continuous attraction for those at the Convention. About fifty exhibitors added much to the value of the meeting by supplying complete technical information on products. Competent engineers were on hand at every booth to answer specific questions.

Exhibitors vied for attention of the 2,550 attending the meeting with gimmicks and give-aways. Intrusion-Prepakt invited all to guess, estimate, or calculate the weight of a block of Prepakt high-density concrete. Visitors were told the density of the block and provided with a tape to measure and then measure again. Many engineers took up the challenge with a seriousness worthy of a major construction project. Some of the best sliderules in the country got stiff workouts. Then, there were those hardy souls who risked strained backs and slipped discs in attempting to lift the block. Usually these guessers were high, an indication that some engineers are out of condition. For the guesstimators who didn't win—the correct weight was 153 lb.

AGC-ASCE Joint Cooperative Committee meets during Convention week. Seated are R. E. Lockwood, co-secretary for ASCE; W. W. Wanamaker, acting co-chairman for ASCE; Howard Dixon, co-chairman for AGC; and Frank Twiss, co-secretary for AGC. Standing (in usual order) are Dick Hopkins, AGC; Paul Elsner, AGC; J. M. Sprouse, AGC; Carl Jansen, ASCE; Clinton D. Hanover, Board Contact for ASCE; Harold Blakeslee, AGC; Charles Davis, ASCE; Thomas Shedd, ASCE; and Walter Couse, AGC.



Memorable Social Program

Each year the Annual Convention committees of Metropolitan Section members in charge of arrangements manage to outdo themselves at the seemingly impossible task of providing fresh and interesting social programs. This year the innovations included a get-together on Thursday evening for both men and women, with entertainment calculated to appeal to both, instead of the stag smoker of other years. There was also something new in the fashion show for the ladies at the Waldorf, where clothes were modeled for husbands and children as well as for the ladies. Mrs. Thomas J. Fratar was chairman of the Women's Committee.

ASCE Technical Program Reviewed

Construction Goes Foreign

The Construction Division devoted several sessions to foreign operations. Emphasis was on getting along and getting paid. A. Douglas McKee, president of Perini Limited, Toronto, said that Canadians are more national in feeling now than ever in the past. They have proved that they can do the big jobs well and all work economically, so users of construction services are buying in Canada. For those who plan to work in Canada, Mr. McKee recommended close contact with local construction groups to avoid upsetting trade agreements and creating friction. Public relations is especially important, with a big need for all employees to really like the country and to be prepared to take a part in its development. Salaries for engineers in construction are lower in the starting brackets than in the United States, but advancement can be rapid for those who have ability and adaptability and top pay is high.

Daniel A. Del Rio, representative of the Banco National de Cuba, said that a principal risk to novice overseas contractors is having to deal with foreign currencies. Despite higher interest rates abroad, the American contractor should not become involved in financing the project. There may be wide fluctuations in local currency in relation to the dollars and difficulty in converting such currency. Dollars are needed for other than local employees and for equipment and materials.

In presenting a paper by Henry C. Boschen, M. ASCE, vice-president of Raymond International, Inc., Edward T. Morris, also vice-president with Raymond, informed the engineers that construction in foreign areas is a special art that should be divorced as much as possible from a firm's domestic operations. The overseas contractor, he added, is not just a contractor working abroad, but a man who is often called on to play the role of diplomat, economist, politician, educator, and pioneer. In addition to multiplying all the usual perils of domestic construction, he said, overseas work adds major problems of supply, transportation, currency convertibility, finance, personnel relations, training, climate, manners and morals, protocol, equipment maintenance, and even occasional revolutions. Foreign construction, Mr. Morris said, is a place for the experienced engineer; many contractors, he stated, have failed because of inexperience and lack of proper concept of the field.

Despite the great advances made in the efficiency of heavy construction machinery, labor-saving devices must be used judiciously in foreign countries. A primary reason, said George Havas, M. ASCE, vice-president and general manager of the Henry J. Kaiser Co., Oakland, Calif., is that the utilization of heavy equipment does not provide livelihood for the multitudes which, in many cases, are starving. He continued that because of the lack of ready availability of spare parts and the reduced skill of maintenance mechanics, equipment is expensive and maintenance is substantially higher than it is in the United States. Mr. Havas said that the American engineer who wants to render service abroad should avoid the pitfall of predicting foreign construction costs only on the basis of American experience, unless the type of work is such that a very large amount of specialized equipment is required with a small amount of labor. The paper by Mr. Havas will be a feature of the December issue of CIVIL ENGINEERING.

Former chairmen of City Planning Division's Executive Committee were honored at the Urban Renewal Luncheon, which celebrated the Division's 35th anniversary. chairman of executive committee: the Hon. Prescott Bush, U.S. Senator from Reading, left to right, are Leslie Williams, ex-chairman; J. Cal Callahan, present Connecticut and featured speaker; and former chairmen Frank H. Malley, William J. Shea, John Nolen, Jr., and Harold M. Lewis; and Fred W. Tuemmler, former member of executive committee.

Power

One of the subjects of the Power Division sessions at the Annual Convention was the Arthur Kill Steam-Electric Station of the Consolidated Edison Company on Staten Island in New York. T. R. Galloway, structural engineer for Con Edison, described the civil engineering features. A 25,000-kw unit went into service in 1947, and when it was decided to add a second unit a general plan was developed for the construction of eight units on the site. This will be the first Con Edison plant that will receive coal by rail, but space has been reserved for deck facilities should water delivery of coal become economical.

A group of engineers were taken to the site of the generating station, and a brief tour of the main station structure was made. This building has a steel frame,

common jumbo brick exterior, and clear glazed jumbo brick interior. Pipe piles were driven to rock and filled with concrete, each was rated at 170 tons capacity. Because of the corrosive soil conditions it was estimated that the pipe would be perforated in 40 years. Therefore column reinforcing in the shape of longitudinal and spiral bars was placed in each pile, so that it could later act as a concrete column.

Irregular topography and wide variations in river flow required some interesting and unusual analytical studies and comparative estimates involving (*a*) the selection of the location of the station on the site and (*b*) arrangement of facilities for generating station "D" of the Potomac Electric Power Company now under construction. R. D. Chellis, M. ASCE, and Emory Ireland, M. ASCE, both structural engineers for the Stone and Webster Engineering Corp., of Boston, informed the group that economic analyses of this type are one of the designer's most difficult tasks, particularly since pressure is usually exerted to start working drawings and construction quickly after the plant is authorized. Some decisions must therefore be assumed before the analyses can be completed.

Shown at session of the Sanitary Engineering Division's Executive Committee are (seated, in usual order) Richard Hazen, John J. Baffa, Arthur D. Caster, secretary, and Richard R. Kennedy, chairman. Standing are Lewis A. Young and Ray E. Lawrence, vice-chairman.

Cooling Towers

Differences in cooling towers for large steam plants in England and the U.S. were also brought out in Power Division papers. R. F. Rish in a paper prepared with T. F. Steel, both of the Central Electricity Generating Board, London, England, described the European hyperbolic natural draft towers. The largest so far constructed is 340 ft high with 260 ft base diameter. Most of this structure is empty with the warm water distribution system 32 ft above the ground over a collection pond and a cooling stack. Cool air entering through the open bottom is warmed by water film or droplets and rises. The shell could be cylindrical, such towers have been built, but the hyperbolic shape stiffens the shell and reduces the surface area and concrete volume.

Present American cooling tower practice was outlined by J. A. Scarola of Ebasco Services, New York. Fans at the top of the tower provide an induced-draft and force moisture laden air higher into the atmosphere, thereby dispersing at greater distance from the tower. Redwood is a favored material for fan stacks, with Heartwood Redwood for packing, in contrast to concrete and a trend toward asbestos-cement sheets for packing in England.

Fish Story

Helping fish to get away has solved a big problem at salt water cooling intakes on the Pacific coast. Robert H. Weight, of the Bechtel Corporation, told a Power Division session how putting a cover over a vertical intake at an existing plant to permit only horizontal flow alerted the fish to danger and reduced the fish trapped at the screenwell from 272 tons per year to only 15 tons. This experimental work was done at the El Segundo plant of the Southern California Edison Company, while planning for the new Huntington Beach steam station where 792 cfs (nearly 500 mgd) will be needed for condensing water for an 800,000-kw station, of which 400,000 kw is now on the line. The intake is located a half-mile offshore with a parallel discharge line 500 ft shorter. Extensive experimental work led to setting a 2-ft horizontal flow gap at the existing El Segudo Station resulting in an entry velocity of 3.5 ft. Observation there resulted in use of a wider gap, 4.5 ft, and lower velocity, 2 ft, at Huntington Beach as fish seemed to be warned by this movement without being drawn into the intake. Vertical flow, before the cap was placed, did not alert the fish as does the horizontal flow, and twenty times as many fish were killed and had to be handled.

Highways and Traffic

Alger F. Malo, director of the Department of Streets and Traffic in Detroit, presented a paper on the subject of "Electronic Control Applied to Limited Access Highways." Highway and traffic engineers are looking to the electronics industry for the solution to some of the problems of controlling traffic on the nation's highways. The major problems to be solved are the hazards of stopped or slow-moving vehicles, adverse weather conditions, and merging movements at interchanges.

Presently being tested is an automatically guided automobile, driven on a road having a built-in guidance system in the form of an electronic cable embedded in the pavement. One safety device under study is radar-controlled brakes. Another now being offered as optional equipment by one of the automobile companies is a push-button automatic driving aid. The device provides automatic control, acts as a speed reminder, and enables the motorist to cruise on the highway without keeping his foot on the accelerator. Still another safety measure is equipment that provides an audible warning when a preset speed has been reached.

Tankers and Ports

Waterways and harbor engineers heard about big tankers that challenge present facilities. The T2 tanker, developed in World War II with a 21,800 ton displaced weight, has been dwarfed by many huge tankers, A. D. Quinn, of the Frederick Snare Corporation, said. Mr. Quinn cited the loaded-draft requirement of 46 ft for the 109,000-ton super tanker Universe Leader compared with established minimum channel depths of 40 ft in the Delaware River, 41 ft for the Panama Canal, and 34 ft for Suez.

Barnett Silveston, of Tippetts-Abbett-McCarthy-Stratton, New York, offered the solution of offshore mooring in deep water served by submarine pipelines for discharging huge tankers, which range up to 950 ft in length with some planned for

18-ft draft. Caltex in Sumatra now has a successful 22-in.-dia submarine line to a mooring 1,700 ft offshore.

Hydraulics

Model studies have achieved a position of great importance on spillway design stated Marvin J. Webster, M. ASCE, head of the Hydraulics Section, Portland Division of the Corps of Engineers. Both improvement of design and financial savings have resulted from the use of such models. In discussing spillway design for Pacific Northwest projects, Mr. Webster stated that spillway crests can be designed for less than the maximum crest. He further explained that some cavitation erosion is acceptable since maintenance costs once in, say, 500 years would be less than the cost of a greater spillway design.

Waterways

Among the many timely and interesting subjects presented by the Waterways and Harbors Division was that of harnessing the tides for future power.

Brig. Gen. Alden K. Sibley, M. ASCE, New England Division Engineer for the Army Corps of Engineers, informed the group that an optimum project arrangement for the use of tidal power as a new source of energy at Passamaquoddy between Maine and Canada has been devised after a $3,300,000 engineering investigation. The project, which would generate electric power from the world's highest tides in the Bay of Fundy, would have a capacity of about 1.9 billion kwhr, using thirty 10,000-kw generators. Additional information concerning the studies at Passamaquoddy will be presented by General Sibley in a future issue of CIVIL ENGINEERING.

Water flow conditions that approximate "tides" on the Tennessee River have complicated the modernization program in the vicinity of the Tennessee Valley Authority's Wilson Dam Project. Rex A. Elder, head of the Hydraulic Operations and Tests Section, TVA, at Norris, Tenn., said that scale-model tests involving the proposed changes at Wilson resulted in "tides" up to 5.6 ft during a period as brief as 1½ hours. The "tides" are caused by steady discharges from the turbines operating at high capacity, fomenting cross currents that make passage to the opening to the canal extremely difficult. He said, however, that after studying the 1:100 scale model, modifications of designs have now effectively eliminated the cross-current problems.

ASCE QUARTERLY ENGINEERING SALARY INDEX

Consulting Firms

City	Current	Last Quarter
Atlanta	1.11	1.11
Baltimore	1.11	1.11
Boston	1.15	1.13
Chicago	1.30	1.26
Denver	1.22	1.19
Houston	1.12	1.08
Kansas City	1.14	1.14
Los Angeles	1.16	1.16
New York	1.20	1.17
Pittsburg	1.05	0.93
Portland (Ore.)	1.15	1.15
San Francisco	1.19	1.17
Seattle	1.06	1.07

Highway Departments

Region	Current	Last Quarter
I, New England	0.91	0.85
II, Mid. Atlantic	1.17	1.17
III, Mid. West	1.25	1.15
IV, South	1.09	1.07
V, West	1.00	0.97
VI, Far West	1.15	1.15

Figures are based on salaries in effect as of May 15, 1958. Base figure, the sum of Federal Civil Service, G. S. Grades 5, 7, and 9 for 1956, is $15,930.

Board of Direction Actions Reviewed

The Board of Direction met at the Statler-Hilton Hotel in New York, October 13-14, 1958, with President Louis R. Howson presiding. Among the actions taken were the following:

On recommendation of the **Budget Committee,** Francis S. Friel, chairman, the Board adopted a budget of $1,642,500 for the 1959 fiscal year, the highest in Society history. The funds provided will permit continued expansion of many important Society activities, particularly in publication and Technical Division work.

Preparation of a movie, "The Civil Engineer at Work," was authorized, and the sum of $5,000 was appropriated from the Voluntary Fund to investigate and proceed. A committee, consisting of R. Robinson Rowe, chairman, R. H. Sherlock, and John E. Rinne, was named to carry out the project.

The balance in the **Voluntary Fund** on September 30 was $85,492.75.

The Daniel W. Mead Award was announced for the best paper on ethics prepared by a member of a Student Chapter. William G. Benko, member of the University of California Student Chapter, was the winner for his paper entitled "Ethical Aspects of Current Practices in the Recruitment of Graduating Engineers." No Junior Member Award was made.

For many years ASCE has owned a property and building, at **220 West 57th Street, New York City,** formerly occupied as its Headquarters. A task Committee, consisting of Richard E. Dougherty, chairman, George W. Burpee, Clinton D. Hanover, Jr., and David G. Baillie, was named to study and report on its present and future status. The property is clear of encumbrances and returns a net $33,000 per year to the Society's income.

The Board took favorable note of the effectiveness of the conferences between **industry** and **education** that have been developing to strengthen the educational program in the metropolitan area of Los Angeles, and recommended that **the Southern California Industry-Education Council's** program be brought to the attention of all ASCE Local Sections for consideration and application as may be appropriate in their areas of interest. One of the leaders in the development of the "Industry-Education" movement is Director Finley B. Laverty. The subject is scheduled for presentation at the Los Angeles Convention in February 1959.

The Committee on Engineering Education, M. J. Shelton, chairman, reported to the Board its unanimous approval of the Board's action in urging **the merger of Engineer's Council for Professional Development,** and **Engineer's Joint Council** with the understanding that ECPD would retain in the merger an autonomy similar to that of the Engineering Manpower Commission.

On recommendation of **the Committee on Junior Members,** Frank Edwards, chairman, the Board directed that "A Professional Guide for Junior Members" and a revised Personal Appraisal Form, when available from ECPD, be sent to all newly elected Junior Members during the next fiscal year; the budget adopted by the Board provides necessary funds.

Local Section Conferences at the following locations and dates were recommended by the Committee on Local Sections, John C. Voorhees, chairman, and approved by the Board:

New Board of Direction meets during Annual Convention in New York. Starting at corner of table and proceeding clockwise are: Director Howard F. Peckworth; Director Wayne G. O'Harra; Vice-President Samuel B. Morris; Director William J. Hedley; Director Charles W. Britzius; Director Randle B. Alexander; Director Fred Rhodes; Director Earl F. O'Brien; Director Thomas J. Fratar; Director Craig P. Hazelet; Director Finley B. Laverty; Director Don H. Mattern; Director Weston S. Evans; Vice-President Paul L. Holland; Vice-President Waldo G. Bowman; Director Clinton D. Hanover; Past-President Louis R. Howson; Executive Secretary William H. Wisely; President Francis S. Friel; Assistant Secretary E. Lawrence Chandler; Past-President Mason G. Lockwood; Director John E. Rinne; Director E. Leland Durkee; Director Philip C. Rutledge; Vice-President Lloyd D. Knapp; Director D. B. Ventres; and Director N. T. Veatch. Director Tilton E. Shelburne was unable to be present.

1. Los Angeles, February 9-10, 1959, during the Los Angeles Convention of ASCE
2. Northeastern, spring of 1959, during either the District 3 Council or the New England Council
3. Helena, Mont., spring of 1959, during meeting of the Pacific Northwest Council
4. Cleveland, Ohio, May 4-5, 1959, during the Cleveland Convention of ASCE

Manual 29 on the "Private Practice of Civil Engineering for the Use of Engineers and Clients"—in preparation during the past two years by the Committee on Professional Practice—was approved in manuscript form for publication. Fee curves have been extended to include projects costing up to $100,000,000, and special curves for freeway projects are included. Manual 29, in revised form, is scheduled to be available early in January 1959.

Faculty Advisers Conferences were scheduled as follows, on recommendation of the Committee on Student Chapters, Charles E. Clarridge, chairman:

1. During the Los Angeles Convention, February 1959
2. During the Texas Section's spring meeting

Publication of a Student Chapter newsletter was approved. It will be mailed periodically from Society Headquarters to officers of Student Chapters.

The Committee on **Engineers in Public Practice,** G. P. Willoughby, chairman, submitted the following resolution which was adopted by the Board:

> Be it resolved that Civil Service Commissions, boards, or like organizations dealing with the classification of professional and scientific personnel in public practice, be asked to give favorable consideration to the employee's affiliation with nationally recognized professional and scientific societies in the establishment of his professional status. Recognition of such affiliation should be made a part of the qualification manual, guide, or document used by an examining board, or like body in the determination of professional competence in the specialties of the engineering profession.

The Board approved another recommendation of the Committee on Engineers in Public Practice, namely to add to the present nine-man committee one member representing the Uniformed Services. A change in Article VII, Section 4 (*i*) of the Bylaws to effectuate the action was given its "first reading." The Board endorsed in principle still another recommendation "that legal registration be a required qualification for all professional engineers in public practice who hold responsible positions."

Recognizing the effectiveness of the Society's nine **District Councils** of Local Sections, the Board expressed the hope that Local Sections not now members of Councils would organize themselves in a similar manner.

Past President Enoch R. Needles was named **Assistant Treasurer of the Society** succeeding Past President Carlton S. Proctor who resigned.

The draft of a "**Recommended Guide to Bidding Procedures on Engineering Construction,**" the product of a joint AGC-ASCE committee headed by Charles B. Molineaux for ASCE, and Howard Dixon for AGC, was approved for publication. It is scheduled for publication early in 1959.

The Committee on Convention Policy and Practice is responsible for approval of Convention budgets. The Board gave the Committee authority to approve Convention budgets indicating deficit financing up to $2,500 from Society funds for certain expenditures for any one convention, if such financing is deemed necessary by the Committee to carry on satisfactory Convention activities.

ASCE Membership as of October 9, 1958

Members	10,145
Associate Members	14,249
Junior Members	17,324
Affiliates	75
Honorary Members	46
Total	41,839
(October 9, 1957	40,305)

Proposed United Engineering Center

On United Nations Plaza

Planning and fund raising for the construction of the United Engineering Center on United Nations Plaza in New York City are the most important current activities of the five Founder Societies. Both of these activities are headed up through United Engineering Trustees.

The Building

Shreve, Lamb and Harmon Associates, architects for the proposed UEC building, are developing the plans. Studies for the exterior include stainless steel or aluminum with porcelain enamel, limestone or glass. Since the cost of the skin is estimated at about 12 percent of the cost of the building, considerable thought is being given to both aesthetic appearance and cost. Pictured on the opposite page is a current study of the 47th Street face of the building looking northwest. The present planning provides for a 20-story tower occupying 25 percent of the plot area—the maximum allowed under New York City ordinances.

The basement and the first two stories, which will occupy the full plot area, will be devoted to those purposes which require large movements in and out, such as meeting and conference rooms, engineering and scientific exhibits, cafeteria, library, storage, and centralized services such as receiving, storing, shipping, and mail handling to be available to all the societies occupying the Center. The general planning calls for the use of the tower for the offices of the individual societies.

The estimated gross area will be about 280,000 sq ft and the net usable area about 190,000 sq ft, the difference being required for mechanical equipment, elevators and elevator lobbies, corridors, and shafts.

The building site has been cleared except for an operating gas station and an occupied tenement building on 48th Street. In clearing the title to the property, a three-inch strip of land was the subject of a dispute. A court judgment fixed compensation in the amount of $1,000 to settle the dispute. The amount has been paid by UET thus clearing the title. It is expected that the two remaining buildings will be razed by the first of the year.

It is planned that no construction contracts will be entered into until funds in the form of cash or pledges are in hand; and that conventional competitive bidding procedures will be followed in the selection of the contractors to be engaged in the construction of the Center.

In addition to the United Nations buildings and park, which border on the East River across United Nations Plaza from the UEC site, other neighbors include the Carnegie Foundation Building and a new office building to house the U. S. delegation. On the aerial picture of the mid-town area of New York on the cover of this issue the artist has superimposed the proposed United Engineering Center on the now vacant site between 47th and 48th Streets. The East River is in the immediate foregound with the East Side Drive bordering it. Across the city to the west is the Hudson River and in the far background lies New Jersey. Landscaping of the UN Park across the street from the Center has been completed.

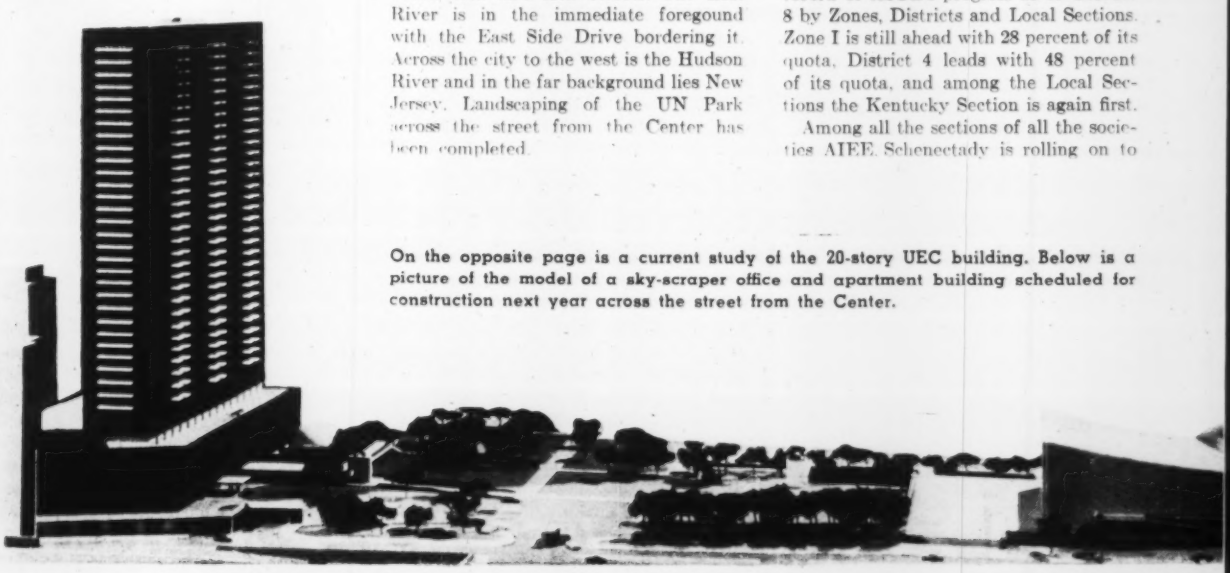
Ground will be broken soon after the first of the year for the construction of a 35-story office and apartment building diagonally across the United Engineering Plaza from UEC. It will occupy the parking lot shown on the cover picture just above the words "United Nations Plaza" in the caption. A photograph of the model of the building, to be made available for UN delegations, is shown across the bottom of this page, as this new skyscraper neighbor would appear from a tower window of the United Engineering Center when both are completed.

Fund Raising

Funds, in the form of pledges and gifts are being received by UET at an increasing tempo. Table I on the next page shows that ASCE has reached 18 percent of its quota of $800,000, and that all member gifts have reached 25 percent of the goal of $3,000,000. Industry gifts have reached nearly three-quarters of its $5,000,000 target. In summary, more than half of the quota has been reached. The past month has been the biggest of the fund raising campaign. Richard E. Dougherty, general chairman of the Member Gifts Campaign, notes "We have reached nearly three-quarters of our first million. As just over 5 percent of the 190,000 members of the societies have contributed 25 percent of the goal we are reasonably optimistic that we will reach our $3,000,000 goal by the year's end."

Table II, also on the next page, is a record of ASCE's progress as of October 8 by Zones, Districts and Local Sections. Zone I is still ahead with 28 percent of its quota. District 4 leads with 48 percent of its quota, and among the Local Sections the Kentucky Section is again first.

Among all the sections of all the societies AIEE Schenectady is rolling on to



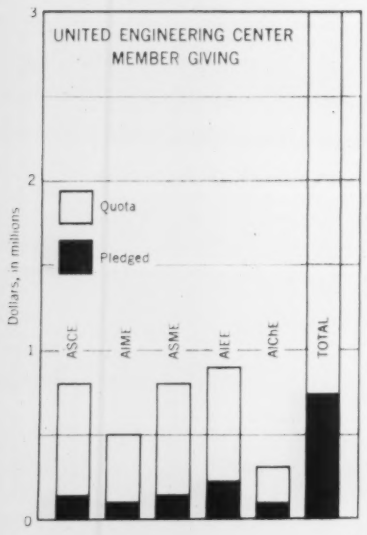
On the opposite page is a current study of the 20-story UEC building. Below is a picture of the model of a sky-scraper office and apartment building scheduled for construction next year across the street from the Center.

150 percent of its quota. ASME Waterbury hit 100 percent from 2 percent of its membership. AIME Utah wired that it had its full quota in the mail. AIChE St. Louis, with its full quota in hand, wired for permission to go on to 200 percent of its quota.

Members throughout the world are helping. During September subscriptions came from twelve countries outside the United States. An ASME member phoned from London to make his contribution. An ASCE member from Iran wrote, "This is a project that every professional engineer in the United States should unhesitatingly support." ASME reported that 66⅔ percent of its members in the big new state of Alaska had contributed. It is certain that by now the third member there has contributed. Gifts have come from Australia, Holland, Spain, Switzerland, Germany, Mexico, the Philippines, the Belgian Congo, the Netherlands Antilles, Canada, Hawaii, and Puerto Rico. Every member can help in this once-in-a-lifetime effort by contributing his time to the campaign and by making a modest contribution.

TABLE 1. PLEDGES to UEC as of October 17

Society	Goal in Dollars	No. of Subscribers	Amount Pledged	% of Goal
ASCE	800,000	1,225	143,633	18
AIME	500,000	312	102,967	20
ASME	800,000	2,077	148,278	19
AIEE	900,000	4,806	225,308	25
AIChE	300,000	603	98,313	33
Others	.....	61	21,961	..
Total	3,000,000	9,084	740,459	25
Industry	5,000,000	198	3,643,633	73
Grand total	8,000,000	9,282	4,384,092	55



ASCE Giving for UEC Passes $125,000 as of October 8

Local Section	Quota	Amount Pledged	% Quota
ZONE I	$197,300	$56,153	28
District 1	**133,300**	**51,081**	**38**
Brazil	2,100	.....	..
Metropolitan	119,200	51,081	43
Panama	1,300	.....	..
Puerto Rico	3,100	.....	..
Rep. Colombia	2,400	.....	..
Venezuelan	5,200	.....	..
District 2	**43,400**	**1,867**	**4**
Connecticut	11,000	.....	..
Maine	4,700	150	3
Massachusetts	23,000	1,517	7
New Hampshire	1,800	100	6
Rhode Island	2,900	100	4
District 3	**20,600**	**3,205**	**15**
Buffalo	4,400	1,585	36
Ithaca	2,400	15	1
Mohawk-Hudson	7,500	1,585	21
Rochester	1,900	.....	..
Syracuse	4,400	20	1
ZONE II	169,700	26,578	16
District 4	**34,000**	**16,351**	**48**
Delaware	4,100	780	19
Lehigh Valley	4,200	2,605	62
Philadelphia	20,000	11,916	60
Central Pa.	5,700	1,050	18
District 5	**27,000**	**515**	**2**
Nat'l Capital	27,000	515	2
District 6	**49,000**	**5,227**	**11**
Maryland	15,000	2,806	19
Pittsburgh	17,000	1,496	9
Virginia	13,300	925	7
West Virginia	3,700	.....	..
District 10	**59,700**	**4,485**	**8**
Alabama	8,900	560	6
Florida	11,500	210	2
Georgia	11,000	1,815	17
Miami	5,200	75	1
Nashville	2,700	.....	..
N. Carolina	6,300	850	14
S. Carolina	4,900	345	7
Tenn. Valley	9,200	630	7
ZONE III	202,200	21,634	11
District 7	**39,000**	**885**	**2**
Duluth	1,500	.....	..
Michigan	18,000	250	1
Northwestern	8,000	.....	..
Wisconsin	10,700	635	6
So. Dakota	1,700	.....	..

Local Section	Quota	Amount Pledged	% Quota
District 8	**37,100**	**4,033**	**11**
Cent. Ill.	6,500	170	3
Illinois	29,000	3,865	13
Tri-City	1,600	.....	..
District 9	**45,700**	**7,526**	**17**
Akron	3,100	.....	..
Central Ohio	5,100	50	1
Cincinnati	4,700	1,405	30
Cleveland	9,300	575	6
Dayton	3,300	.....	..
Indiana	11,000	906	8
Kentucky	6,100	4,590	75
Toledo	3,100	.....	..
District 14	**31,500**	**7,343**	**24**
Mid-Missouri	3,500	350	10
Mid-South	11,000	3,005	27
Oklahoma	6,900	.....	..
St. Louis	10,100	3,990	39
District 16	**48,000**	**1,843**	**4**
Colorado	13,900	603	4
Iowa	5,900	210	4
Kansas City	12,000	1,000	8
Kansas	7,600	.....	..
Nebraska	6,300	30	1
Wyoming	2,300	.....	..
ZONE IV	230,800	20,980	9
District 11	**132,600**	**19,240**	**15**
Arizona	5,000	950	19
Hawaii	6,300	.....	..
Intermountain	4,700	.....	..
Los Angeles	50,200	3,330	7
Sacramento	16,300	100	1
San Diego	6,000	.....	..
San Francisco	44,100	14,860	34
District 12	**40,400**	**873**	**2**
Alaska	2,200	.....	..
Columbia	2,200	150	7
Montana	3,300	.....	..
Oregon	10,900	.....	..
Seattle	12,200	.....	..
S. Idaho	2,300	.....	..
Spokane	3,100	38	1
Tacoma	4,200	685	16
District 15	**57,800**	**867**	**2**
Louisiana	13,000	.....	..
Mexico	1,400	.....	..
New Mexico	4,000	.....	..
Texas	39,400	867	2
	$800,000	$125,345	16

Conference on Electronic Computation

The keynote address at the forthcoming Conference on Electronic Computation, set for Kansas City, Mo., November 20 and 21, will be on the "Philosophical Implications of High-Speed Computing Machines." It will be given by Norman Dalkey, chief of the planning analysis team, Office of the Assistant for Operations Analysis, Department of the Air Force, Washington, D. C.

Mr. Dalkey's address will show how the computer has done much more than revolutionize the art of calculation. It will show that it has created a subject matter of profound significance for mathematics, the life sciences, and philosophy. Says Mr. Dalkey: "The increasing frequency with which questions are raised, such as 'Can digital computers think?', 'Are there types of problems solvable by human beings but unsolvable by computers?', indicates that a reevaluation of man's place in nature as profound as the Copernican or Darwinian revolutions is in the making. The program was printed in the October issue.

News about Allis-Chalmers construction machinery . . .

Tractor power helps build Navajo Dam...40 stories high

Morrison-Knudsen Co., Inc. is sponsoring contractor on the Navajo Dam job in a joint venture with Henry J. Kaiser Co. and F & S Contracting Co.

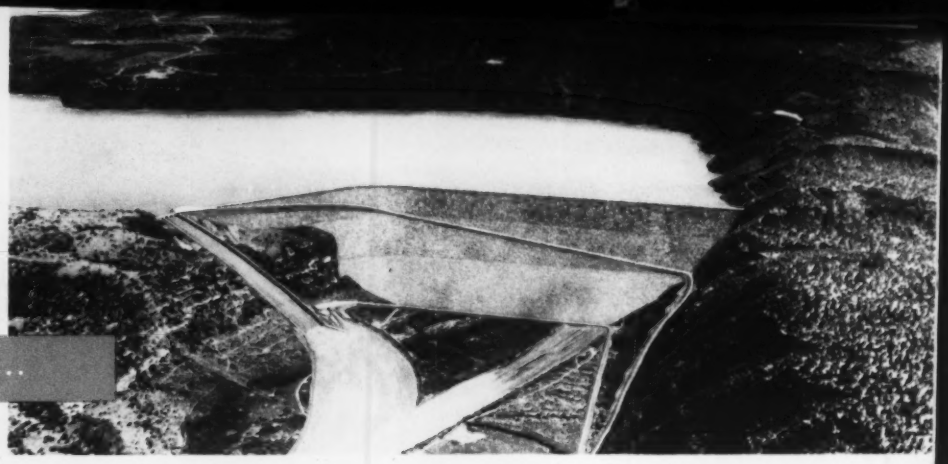
Right now, the dam you see here exists only in the minds of its builders. Spanning a sun-baked canyon in New Mexico, it will create a lake 37 miles long . . . enough water to irrigate many thousands of thirsty acres. But towering Navajo Dam, one of the world's largest earth-fill structures, will take four more years to complete. Sponsoring contractor is world-famous Morrison-Knudsen . . . already moving the first of 26 million yards of dirt and rock that will test tractor performance and dependability as severely as any job can. M-K's choice — big Allis-Chalmers crawlers with turbocharged diesel power, hydraulic torque converter drive, and the toughest track ever made. Allis-Chalmers, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

Construction Machinery Division • Engine-Material Handling Division • Farm Equipment Division • General Products Division • Industrial Equipment Division • Nuclear Power Division • Power Equipment Division • Allis-Chalmers International

POWER FOR A GROWING WORLD

OVER

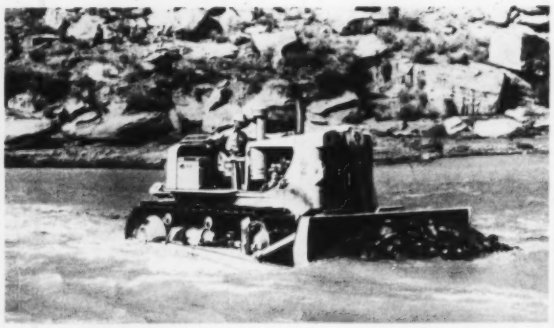


How it will look—The finished dam will be 3800 feet wide, 3200 feet thick at its base . . . and will create the biggest body of water in New Mexico.

picture report.....

Allis-Chalmers big HD-21's get Navajo Dam under way

24-foot-wide dozing team—Torque converter HD-21's match power and speed precisely, as they work together to push huge mounds of dirt and rock over the cliff to prepare for construction of a spillway.



No worries about river work—Positive-seal protection of vital track parts lets the HD-21's doze rock from the river bottom to form approaches for a temporary bridge without fear of lubricant loss or track damage.

Heavy-duty power for heavy-duty haul roads—Big Allis-Chalmers Forty Five motor graders fit the Navajo job to a "T." Clean, uncluttered design lets operator see both ends of the moldboard easily as he cuts a roadside ditch.

Four plus yards at a crack—This Allis-Chalmers HD-21G, biggest tractor shovel available anywhere, is helping to load about 40,000 yards of rock and dirt to clear the way for construction of a diversion tunnel.

See for yourself why Allis-Chalmers equipment was chosen for the Navajo Dam job. Your Allis-Chalmers dealer will demonstrate machines to fit your requirements . . . on your job—no obligation. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin

ALLIS-CHALMERS ***POWER*** **FOR A GROWING WORLD**

4 OVER MS 1317

Litho in U.S.A.

Objectives of Proposed Changes in Membership

At the request of the Board of Direction on June 24, 1958, the Task Committee on Classification of Members prepared the following statement explaining the proposed changes in membership grades and setting forth the reasoning on which the amendments are based. The membership of the Task Committee is as follows:

Randle B. Alexander
Don M. Corbett
Clarence L. Eckel
William S. LaLonde, Jr.
Mason C. Prichard
John P. Riley
Thomas C. Shedd
Lowber D. Snow
Graham P. Willoughby
Frank L. Weaver, *Chairman*

Early in its deliberations the Task Committee on Classification of Members concluded that criteria should be developed and after consideration of the material available to it, including voluminous comment and suggestion by the Society membership, adopted the following:

1. *Maintenance of membership standards.* There should be no watering-down or lowering of standards of any of the present engineer membership grades; rather, these standards should be raised, if this could be accomplished reasonably, in the interest of enhancing the professional standing of the Society and of its members. This is especially important in view of indications of the growing stature of engineers and physical scientists in the eyes of the people of the United States.

2. *Registration.* At the appropriate place in the specifications for membership grades, legal registration as an engineer should be a requirement. The Committee believes that, at this time, registration should be a requirement for the top membership grade only.

3. *Engineer-in-Training Certificate.* An acceptable Engineer-in-Training Certificate should be recognized as meeting the requirements for admission to the lowest grade in lieu of graduation from an engineering college of recognized standing.

4. *Managerial positions.* Recognition of trained and experienced engineers in managerial positions should be further defined, with the view to reducing to a minimum involuntary separations from the Society on account of insufficient professional engineering experience to meet requirements for transfer to a higher grade.

5. *Student relations.* The close relation of civil engineering students to the activities and operations of ASCE should be maintained and enhanced if practicable.

6. *Nomenclature.* The name designations for membership grades should be in general accord with those used by the majority of the Founder engineering societies and recommended in the ECPD report.

The Task Committee on Classification of Members believes that the proposed amendments to the Constitution would serve to accomplish the above objectives. As pointed out in the foregoing, however, there has been demand for changes in the titles or nomenclature, and in the qualifications as presently defined. The Task Committee believes that the following would meet these objectives:

1. *Fellow.* This grade would take the place of the present Member grade, but would differ from it in these main respects:
   (*a*) Minimum age would be increased from 35 to 40 years;
   (*b*) Minimum years of responsible charge would be increased from five to eight years;
   (*c*) Legal registration as an engineer would be a requirement for membership in the grade; and
   (*d*) Admission would be only by transfer from the grade of Member after not less than five years of responsible charge of important engineering or other appropriate work in the grade of Member.

   Among the Founder Societies, the American Institute of Electrical Engineers and the American Society of Mechanical Engineers use Fellow for the top grade. ECPD has recommended the title of Fellow.

2. *Member.* This grade would take the place of the present Associate Member grade, but would differ from it in these main respects:
   (*a*) Minimum age would be increased from 25 to 27 years; and
   (*b*) Minimum years of responsible charge would be increased from one to three years.

   Membership would be by advancement from the grade of Associate Member or by direct admission, and in this respect there would be no change from the present requirements.

3. *Associate Member.* This grade would take the place of the present Junior Member grade, but would differ from it in these main respects:
   (*a*) An applicant who is not an engineering graduate from a school of recognized standing would not be eligible for admission at this grade unless he has an acceptable Engineer-In-Training certificate; and
   (*b*) Transfer to another grade instead of being mandatory at age 32 would be mandatory 12 years after admission to Associate Member grade unless, as now, an extension is granted for intervening military service.

If these proposed amendments are approved by the membership of the Society, then to accomplish the change, all Members, Associate Members, and Junior Members at the time of final approval would automatically have the names of their membership grades changed respectively to Fellow, Member, and Associate Member.

There are undoubtedly a large number now in the present Junior Member or Associate Member grades who are well qualified under present rules for transfer to a higher grade, but who have never taken the trouble to apply for transfer. Those who are in the Junior Member or Associate Member grades at the time of adoption of these proposed amendments to the Constitution would be granted a grace period of one year in which they might apply for transfer under present rules.

All applications received from nonmembers would be considered in accordance with the proposed provisions of the Constitution except for those received prior to the date of adoption of the amendments.

At the beginning of its deliberations, the Committee was favorably inclined to the often-expressed view that the classification of Member of a Student Chapter should be changed to a new Student Member Classification. To assist the Committee in its deliberations, Executive Secretary Wisely presented an analysis

which showed that a much higher percentage of students graduating in civil engineering join ASCE than is correspondingly the case with the other Founder Societies. Under the proposed amendments, the present system of membership in Student Chapters would be continued.

Mr. Wisely presented an analysis of membership losses for the three year period, 1954-1956. His analysis shows that while the loss from the entrance (now Junior Member) grade was 8.4 percent, it was only 1.5 percent from all of the other grades combined. This loss was less than the corresponding loss in any other Founder Society. A substantial part of the loss from entrance grade results from the fact that many in this grade had developed specific pursuits not of sufficient engineering character and responsible charge or of sufficient attainment in management, sales, administrative, or promotional activities to warrant their advancement to next higher grade. Under the present Constitution these members must be dropped from the Society.

With a view to remedying this situation, the proposed amendments would change the requirements for Affiliate grade. The minimum age limit would be lowered from 35 to 27, and the years of responsible charge in an applicant's special pursuit would be lowered from five to three years. In these respects, the new requirements would be of a standard parallel to those recommended for the new Member grade. If these new requirements for membership in Affiliate grade are adopted it is believed that many members in the entrance grade who now must be dropped because of inability to advance to the next higher grade may find it possible and desirable to continue their membership in ASCE in the new Affiliate grade. Except for members in the present Affiliate grade at the time the proposed amendments may be adopted, an Affiliate would not have the right to vote or to hold office.

No changes are proposed in the qualifications for Honorary Membership. The limit on the total number of Honorary Members, presently set to not exceed one for every 750 members, would be removed. The existing limitation of one to 7,500 appears to offer all of the selectivity needed to retain the distinction of this grade.

Entrance fees would be as follows:

Associate Member	$10.00
Member	25.00
Affiliate	25.00

However, there would be no entrance fee for the new Associate Member grade for graduates who have been members of Student Chapters and who apply within 60 days after graduation, and there would be no fee for transfer between grades.

Annual dues would be:

Associate Member—	
First seven years after admission to this grade	$15.00
Thereafter	25.00
Member	25.00
Fellow	25.00
Affiliate	25.00

An analysis by the staff of the financial impact of all of the recommended amendments indicates that there probably would be some small net increase in annual income to the Society.

The Committee believes that under the recommended amendments to the Constitution those admitted to the Society would be better qualified; that the tendency to seek transfer to higher grades before attaining the necessary qualification would be reduced, with a lessening in the number of declinations for the highest grade and an increase in applications for and acceptance in the intermediate grade.

The proposed amendments are to be presented to the membership as a package unit for one vote of "Yes" or "No". A comparison of the present and the proposed Constitution in those areas where changes would take place has been mailed to every member. Another copy will be included with the ballot.

Status of Surveyors Defined by Task Committee

A Task Committee on Status of Surveying and Mapping appointed to report on (*a*) which parts or activities of surveying and mapping are professional and (*b*) which parts or activities of surveying and mapping are engineering has submitted its third and final report to the Division's Executive Committee for transmittal to the ASCE Board of Direction. Revising some earlier ideas (March 1957 issue, vol. p. 189), the committee now submits the following conclusions and recommendations:

1. That the overall definition of the field of surveying and mapping comprising six principal categories: (*a*) land surveying, (*b*) engineering surveying, (*c*) geodetic surveying, (*d*) cartographic surveying, (*e*) aerial survey services, and (*f*) cartography, be accepted, and that the difference between professional-level duties and technician-level duties be recognized.

2. That the first four of the six main categories comprising the overall field of surveying and mapping should continue to be regarded as engineering, these being land or property surveying, engineering surveying, geodetic surveying, and cartographic surveying; that these four categories should be considered as comprising the field of survey engineering (or geodetic engineering, or geometronic engineering), which in turn should be regarded as a branch of civil engineering; and that all state registration boards, engineering societies, and similar professional groups should recognize professional-level experience in this field as professional engineering experience. The committee submitted an extensive chart suggesting separation between professional-level and technician-level duties. This has only minor changes from the classifications shown in the March 1957 issue.

The group recommended continued accredited study in basic surveying and that some schools should offer an elective of 16 to 20 semester hours that would be a "major" in survey (or geodetic or geometronic) engineering. In addition at least one engineering school should offer graduate degree programs in the principal survey engineering fields, such as land surveying, geodetic, cartographic and photogrammetric engineering.

A recommendation for "an appropriate time" in the future is that those who wish to engage in land surveying and related engineering work should first be required to qualify for a professional license.

The committee has contacted all known interested organizations and a great many individuals in formulating this policy. It has been endorsed by the Executive Committee of the Surveying and Mapping Division, but does not represent ASCE policy until acted upon by the Board of Direction. Members of the Task Committee are: representing federal mapping agencies, George D. Whitmore, Chief Topographic Engineer of the U. S. Geological Survey, Washington; representing private practice and industry, Alfred O. Quinn, chief engineer of Aero Service Corporation, Philadelphia; and representing engineering education, Brother B. Austin Barry, associate professor of civil engineering at Manhattan College, New York, as chairman.

Basic Research Is Defined at Conference

Civil engineering aspects of basic research were fully explored at a recent joint conference held in Washington, D. C., September 10 and 11. Co-sponsors of the joint conference, the first of its kind, were the National Science Foundation, George Washington University, and ASCE through its Research Committee.

Three significant observations emerged from the conference: It is probable that the word "research" was used more times during the program than during all the other meetings conducted under the ASCE banner. It is probable that the meeting of some fifty men was the most representative gathering of civil engineers in research ever sponsored by the Society. It is probable that out of the studies came definitions and conclusions, which will convince civil engineers of their need–and–responsibility for "basic research."

The Research Committee, which is currently headed by Elmer K. Timby, has been struggling to make civil engineers research conscious. It assigned to one of its members, Dean Martin Mason, of George Washington University, the task of planning a meeting or conference that would further the recognition of basic research as an integral part of the professional practice of civil engineering. Dean Mason enlisted the support of the National Science Foundation (ideas, men and money), George Washington University (facilities), and the several Technical Divisions of ASCE (men). Dean Mason served as general chairman for the conference. Dr. Gene Nordby, recently with the NSF, facilitated arrangements and served as a panel chairman. Dr. Raymond J. Seeger, of the NSF, gave a major address defining the relationship of research to "knowledge." The keynote address, "Relationship of Basic Research and Civil Engineering Knowledge," was delivered by Capt. Arthur B. Chilton, Jr., of the U.S. Navy. Panel advisers were Drs. Emerson W. Conlon, of Drexel Institute; Archibald T. McPherson, of the National Bureau of Standards; Frank Croxton, of Battelle Memorial Institute; and F. Leroy Foster, of Massachusetts Institute of Technology.

Panel chairmen, in addition to Dr. Nordby, who led a symposium on "Stimulation and Organization of Research to Increase Civil Engineering Knowledge," were: Dean John S. McNown, of the University of Kansas, leading a panel on "Current Frontiers of Civil Engineering Knowledge;" Dr. Charles T. G. Looney, of the University of Maryland, a panel on "The Need for More Civil Engineering Knowledge;" and Dr. Robert E. Stiemke, of the Georgia Institute of Technology, a panel on "The Responsibility of the Profession and Educational Institutions for Development of Knowledge."

Research committees of the following ASCE Technical Divisions held meetings in Washington either before or after the conference, and participated in the program: Air Transport, Construction, Engineering Mechanics, Highway, Hydraulics, Irrigation and Drainage, Pipeline, Sanitary Engineering, Structural, Soil Mechanics, Surveying and Mapping, and Waterways and Harbors. The technical directors of the Engineering Foundation took part as, of course, did members of the ASCE Research Committee, who followed the sessions with an appraisal meeting of their own.

The conference conclusions are difficult to express in "nutshell" statements. The comprehensive Conference Statement, which will be published separately, concludes that "basic research," as defined, is an integral part of civil engineering, and that this fact must be recognized and accepted if civil engineering, per se, is not to be fragmented even further, losing its identity to a number of highly specialized techniques. The conclusions, with recommendations, are to be made available to ASCE officers and any others who may be interested. Copies are obtainable on request from ASCE Headquarters.

W. W. Horner, Former ASCE President Dies

Members of the Society will be grieved to learn of the death of Past President Wesley W. Horner in St. Louis on September 23, his 75th birthday. Mr. Horner, senior partner in Horner and Shifrin, has been associated with St. Louis in a number of capacities. His work with the city included design and supervision of an extensive program of street widenings, traffic aids, and sewer work. He played a major part in planning a comprehensive sewer system in St. Louis County and in the design of the East Side Levee and Sanitary District.

Mr. Horner's specialties included municipal and sanitary engineering, water supply, and airport design. A graduate of Washington University, Mr. Horner was awarded an honorary doctorate of engineering from his alma mater in 1952. He was a lecturer in engineering and later a professor of municipal and sanitary engineering at Washington University. In 1953, former President Hoover named Mr. Horner to a 26-man task force study of federal activities in the field of water resources and power development. As chairman of the National Water Policy Panel of Engineers Joint Council, he was instrumental in preparing the guide, "Principles of a Sound National Water Policy," which has been widely used as a reference.

Past-President W. W. Horner
(1883-1958)

A member of the Society for 50 years, Mr. Horner served a term as Director from 1933-1935, and as President in 1946. He was a recipient of the Gold Achievement Award Medal of the Engineers Club of St. Louis and he recently received a medal for distinguished service in engineering from the University of Missouri.

The Younger Viewpoint

The Voice of the Committee on Junior Member Publications

Now four months old, your "younger viewpoint" page is hungry for comments and remarks. Its purpose of better dissemination of young ideas among all civil engineers will be best served by a piece of your mind! Contact your Zone chairman now.

Committee on Junior Member Publications

Milton Alpern, Chairman; 3536 Northview Ave., Wantagh, L. I., N. Y.

Zone I	Zone II	Zone III	Zone IV
Louis K. Walter, Jr. 320 Market Street Kenilworth, N. J.	Raymond S. Gordon State Planters Bank Building Richmond, Va.	Walter D. Linzing 4751 No. Pauline Chicago 40, Ill.	Rodney P. Lundin 9744 Quakertown Ave. Chatsworth, Calif.

We have received a fine letter from Mariano Ospina H., a civil engineer in Bogota, Colombia, with degrees from M.I.T. and Harvard. He tells of interesting work he has done there in paving, water conditioning, and steam plants, and includes aerial photos of some land improvement work. Space does not permit of details here. He suggests as a better title for this column, "The Newest Approaches," "Younger Views," "Fresh Outlooks," and "Young Engineering."

Time is the enemy of civil engineers, all over. We are sorry to learn that our Zone II Chairman, Raymond S. Gordon, finds that time problems won't let him contribute effectively to the committee work. His replacement must be found soon. Until then Ray will continue to serve.

Carl P. Kroboth, a consulting engineer of Lexington, Ky., likes the proposed grade classification changes. He writes:

"PROFESSION (Definition by Webster) Three professions or learned professions of theology, law and medicine.

"I hope by now all of you Junior Members have read the article in last month's CIVIL ENGINEERING, entitled A New Classification of Members Proposed. If you have not done so, by all means do so at once. This is true because we, as Junior Members, will be affected most in the future by these new proposals.

"Ever since I first became associated with the engineering profession, I have been conscious of one question, which keeps coming up: 'Is Engineering a Profession?' We all know the answer to this or at least we should. Since we know that engineering is a profession, the real problem is to let the public know. I have heard discussions and read many articles on this subject, and I am sure that many great men have put a lot of time and thought into them. However, this is the first action that I am familiar with that gets down to the core of the problem. What better way is there to prove we are on the same plane with other recognized professions than to begin by raising our standards?"

To quote Ken Kraft: "A skeptic is a fellow who won't take know for an answer."

You may be interested in some tentative results of an Engineering Education Survey that has been conducted by the Education Committee of the Nassau County Chapter of the New York State Society of Professional Engineers. Your chairman, as a member of this committee, is compiling the data of the survey, which so far represents the composite opinion of 73 P.E.s, all types of engineers in the metropolitan area. Some interesting definitive conclusions follow:

1. Professional Engineers in general (all ages, all registered, all kinds) think that the undergraduate engineering education that they had five or more years ago was better than adequate.

2. The engineering education obtained by today's young graduate is just less than adequate.

3. Modern engineering education should contain somewhat more training in application of theory and somewhat less theory study.

4. Liberal arts studies are considered important and should be expanded even at the expensé of technical subject time.

5. Education in science and math five or more years ago, is considered to have been just adequate.

6. However, it is suggested that the current graduate have somewhat more preparation in science and math than in the past. (Note conflict with response to question 3.)

7. It is suggested that the engineering societies have no control, but considerable influence, over the contents and methods of engineering education.

8. It is suggested that the accrediting teams that evaluate an engineering college be composed of about equal members of engineering educators and practicing engineers.

9. The optimum experience background of the majority of teachers of undergraduate engineering courses should be engineering graduates who teach part time, practice engineering part time, and are also involved in graduate work to some minimum necessary extent to keep up to date.

10. About options in the undergraduate curriculum, the practicing professional engineer of today feels that none to few options are best.

11. There is some recommendation toward "a general engineering" curriculum for all engineering students.

12. There is an overwhelming recommendation for the installation of honor systems in undergraduate engineering colleges as a means of training in professional attitudes.

These suggestions are tentative and will form the basis of a complete report to be prepared by the committee in the near future.

From Roger Blum, Jr., J.M.ASCE, of Cleveland, Ohio:—

"Really do not like the The Civil Young title suggestion. What do you think of the title, Young Stirring, as a pun on Youngster? Or even Young Stirrings? Oh well—"

It has been said (by H. Thompson), that too many people seem to chart their course by loungetude and lassitude.

Let's hear from you soon.

Division Doings

Both Irrigation and Drainage Needed in Humid Areas

The need for both irrigation and drainage in humid areas was appraised at a "first-time" conference conducted by the Irrigation and Drainage Division in Memphis, Tenn., late in September.

In the heart of a humid area long associated with drainage and flood control, the conference brought to light the increasing need to get the water off the land when it is not needed and put it back when crop cycles can be aided most. This new approach of the Division has been developed through the efforts of its Committee on Humid Areas, under the chairmanship of Paul H. Berg, of Omaha.

Setting the pace for the conference, the opening session, on September 25, was a panel on drought frequencies. The character of droughts was analyzed by M. C. Boyer, of the Indiana Flood and Water Resources Commission, and Leo F. Reynolds, recently with Armco and now in consulting practice in Memphis. The detailed information these men presented, which will be available in published form, prepares for the conclusions reached by the Committee on Humid Areas. These were presented by Mr. Berg, reading a paper prepared by Harold A. Scott, Jacksonville consultant, and by Billy B. Bryan, agricultural engineer from Arkansas.

As civil engineers and agricultural engineers join with agronomists, they find that soil-moisture studies can foresee the water needs throughout crop-growing seasons, match this with drought forecasts, and provide both irrigation and drainage to avoid crop damage and, in fact, increase crop yield. Some of the information presented demonstrated a four-fold increase in yield with controlled water on crops. The civil engineer gets into the act when the economics of the situation is encountered. Both drainage and irrigation cost big money, and must be related to the dollar value of increased yield. In some cases it is apparent that a change in crops would better suit available soil moisture, minimizing the need for nature-aiding processes. Study on this continues of course. There was even some facetious comment on the need for increased crop yield in the face of continued surpluses and government subsidy programs.

All this moving of water about creates problems of water law. Particular interest was paid the session conducted by the Committee on Water Laws, under the chairmanship of James I. Seay, Jr., the new president of the Mid-South Section. Members of the committee presented information on the present status of these laws and proposed new patterns. The experience of New Jersey, which has water laws running back to 1907, was reported by George R. Shanklin, who gave a careful description of the type of laws needed, and the organization necessary to administer them with justice.

Speakers suggested new sources of water. Jerry E. Garrison suggested use of underflow in stream valley alluvia. As a complication, W. R. Liewellyn, of Florida, described the results of sea water intrusion. For control of surface waters, the U.S. Department of Agriculture has traditionally encouraged installation of small dams. The results of this method were reported by C. A. Reese, of the Soil Conservation Service in South Carolina, and J. B. Furr, of the Delta Soil Conservation Service in Mississippi. The benefits to be obtained from underground distribution of irrigation waters were described by W. D. Howell, of Choctaw, in Memphis.

Interrelationship of the many uses of water, as well as the problems of superabundance were discussed by Maj. Gen. William A. Carter, division engineer for the U.S. Corps of Engineers at Vicksburg. General Carter reemphasized the urgent need for a farsighted appraisal of needs and resources, not for one year, or five years, but as far as an engineer can plan for the increasing needs of an exploding population growth. This theme was given specific attention by Col. William P. Jones, Jr., Memphis district engineer, who described the St. Francis River development program. Colonel Jones had planned a most unusual air inspection tour of this project as a part of the conference.

The position of the states in water resource development and control was presented by Roy T. Sessums, Jr., of the Freeport Sulphur Company. Mr. Sessums gave examples of the advantage to a state organization of coordinating efforts to foresee need and provide facilities to drain, irrigate, and otherwise attack the water resource problem.

The general chairman of the three-day conference was O. Martin Carter, with Armco in Memphis. For his outstanding handling of the conference Mr. Carter was awarded an elaborate certificate on behalf of the Division by Howard T. Critchlow, chairman of the Division.

Running concurrently with the conference was the annual meeting of the Mid-South Section. President Harold J. Engstrom conducted Section business, including the award of Certificates of Merit to past-presidents of the Section. A new slate of officers, headed by James I. Seay, Jr., as president was installed.

Chairman O. Martin Carter welcomes Vernon Smith, a Mid-South Section past-president, and Mrs. Smith.

Section President Harold Engstrom compares notes with Mr. and Mrs. Thomas Maxon, of Memphis.

Construction Division Announces Reorganization

A major shift of emphasis characterizes the new program recently put into operation by the Executive Committee of the Construction Division. Awaiting an appraisal meeting before issuing the announcement, the Committee lists as "under full steam" the following new functions being carried on by newly appointed committees:

Insurance and Bonding: Edward R. Higgins, chairman

Contract Documents: Blair Birdsall, chairman

Construction Management: Howard H. Sturdy, chairman

New Building Techniques: Eugene F. Baldi, chairman

Estimating and Cost: Eugene G. Rau, chairman

Job Planning: Roy G. Cappel, chairman

Equipment Maintenance: Edgar S. Garbarini, chairman

Nuclear Facilities: William C. Siler, chairman

Construction Standards: Warren S. Mann, chairman

Construction Research: William W. Moore, chairman

Each committee has undertaken to initiate action which will produce new answers to old questions, and to make available to the engineering profession and construction industry all new information. Dissemination of information and procedures is their business. Periodic reports will be issued, in addition to publications that are being planned. There will also be conferences.

In making this announcement, Division Chairman Walter L. Couse also spoke of additions to his Executive Committee: Lyman D. Wilbur, of Morrison Knudsen, Boise, Idaho; Joseph F. Jelley, Jr., consultant of Colorado Springs, Colo.; and Secretary Michael N. Salgo, civil engineer for the Columbia Broadcasting System, New York.

Second Jet Age Airport Conference

Latest information on noise suppressors and blast fences for jet aircraft is on the program of the Second Jet Age Airport Conference, scheduled for May 20-22, 1959, at Houston, Tex. While the program for the three-day meeting has not been completed, conference committee members already have listed some of the subjects that probably will find their way on the agenda. These include:

"Guiding principles needed for establishment of airport rates and charges for air carriers."

"Experiences in loading, unloading, and servicing of jet transports at terminals.

"The use of prestressed pavements for large aircraft—research and experience."

"Latest thinking for heliport requirements."

"Airport configuration studies—exit taxiway location and design, separation of runways for IFR operations, night guidance, etc."

"Blast fences, design, cost and effectiveness."

"Where do we stand on VTOL and STOL aircraft?"

"Ultimate objectives of the common system of air traffic control."

"Experiences to date on noise suppressors."

The conference is being held under the joint sponsorship of the Society's Air Transport Division and the Houston Branch of the Texas Section.

ASCE CONVENTIONS

LOS ANGELES CONVENTION

Los Angeles, Calif.
Hotel Statler
February 9-13, 1959

CLEVELAND CONVENTION

Cleveland, Ohio
Hotel Cleveland
May 4-8, 1959

ANNUAL CONVENTION

Washington, D. C.
Hotel Statler
October 19-23, 1959

TECHNICAL DIVISION MEETINGS

CONFERENCE ON ELECTRONIC COMPUTATION

Kansas City, Mo.
Continental Hotel
November 20-21

Sponsored by
ASCE Structural Division
Kansas City Section

JET AIRPORT CONFERENCE

Houston, Tex.
Shamrock-Hilton Hotel
May 20-22, 1959

Sponsored by
ASCE Air Transport Division
Houston Branch of
Texas Section

LOCAL SECTION MEETINGS

Los Angeles—Dinner meeting of the Soil Mechanics Group at Rodger Young Auditorium on November 19 at 6:30 p.m.; dinner meeting of the Construction Group at Swally's Key Club on November 20 at 6:30 p.m.; dinner meeting of the Transportation Group at the Engineers Club, Biltmore Hotel, on November 20 at 6:30 p.m.

Metropolitan—Meeting at the Engineering Societies Building on November 19 at 7 p.m.

Philadelphia—Joint meeting with the Philadelphia Section of ASME at the Engineers Club on December 9 at 7:30 p.m.

Pittsburgh—Evening meeting at the Penn-Sheraton Hotel on November 18 at 8:00 p.m.

Sacramento—Weekly luncheon meeting at the Elks' Temple every Tuesday at 12 noon.

Virginia—Norfolk Branch meeting the third Monday of every month at the YMCA Cafeteria at 12 noon; Richmond Branch meeting the first Monday of every month at the Hot Shoppe Cafeteria at 12:15 p.m.; Roanoke Branch meeting the second Wednesday of every month in the S & W Cafeteria at 6:30 p.m.

Presentation of annual Daniel V. Terrell Award for Junior Members was feature of recent District 9 Council meeting in Akron. Shown are (left to right) Dr. J. B. Scalzi, Case Institute of Technology and chairman of Terrell Award Committee; C. P. Hazelet, consultant and ASCE Director for District 9; Floyd F. Schrader, chairman of District 9 Council and district engineer, U. S. Geological Survey; and Sammie F. Lee, this year's winner of the Terrell Award and office engineer for Portland Cement Association.

BY-LINE WASHINGTON . . . . .

Several hundred leading contractors assembled last month to appraise construction prospects in the months ahead and discuss working relationships with engineers. The headquarters office of the Associated General Contractors of America, in Washington, gave CIVIL ENGINEERING these highlights of interest to engineers, from its midyear board meeting.

Engineers are still somewhat in short supply, the contractors said. They OKed moves to alleviate this situation in a number of ways—by widespread circulation of a new AGC recruitment film, "The Constructors," among students; by creating summer work opportunities for both engineering professors and students; and by promoting interest in construction courses in various colleges. The AGC's Education Committee may poll the association membership to determine how many civil engineers they intend to employ during the next year. This group also intends to survey and publicize existing construction curricula at engineering colleges. The contractors want students to receive more instruction in construction project management and production techniques, along with design.

Contractor members of a joint committee with ASCE reported efforts to revise bidding procedures. (A new "recommended bidding guide" that has the blessing of both civil engineers and contractors was approved by the committee at ASCE's New York Convention and will be published soon.) Another task force listed concessions heavy construction contractors have obtained recently from the Corps of Engineers. These include:

- An effort by the Corps to eliminate conflicts between plans and specifications which may be construed to make the contractor liable for costs involved as a result of design inadequacies.
- Agreement by the Corps to clarify the acceptability of the one-stop batch plant for cement and aggregate batching to promote wider use of these units.
- Advice from the Corps that the phrase ". . . or as directed by . . ." will be deleted from specifications as rapidly as possible, and emphasize that use of the phrase should be minimized in project specifications.

* * *

Prediction time in Washington . . . The Department of Commerce forecast last month that new highway construction will reach $5.5 billion by the end of the year —a strong 14 percent over 1957's $4.8 billion. The Bureau of Public Roads, looking way ahead, believes that total capital expenditures for highways will top $6.2 billion this year and go on to $7 billion in 1959, $7.3 billion in 1960, $7.7 billion in 1961; and $8.1 billion in 1962. (This is the first long-range prediction released by the BPR and some observors believe it is purposely conservative.) Over in the Bureau of Labor Statistics, officials are predicting that the total construction volume will keep on climbing through 1959, breaking through $50 billion, compared with this year's anticipated $49.5 billion.

Meanwhile, expenditures from the Highway Trust Fund, specially created to finance the National Highway Program, have started to outrun income. Nearly $4 billion worth of highway user taxes were funnelled into the "kitty" from July 1, 1956, through August 1, 1958, and only $3 billion expended. But the last several months has seen expenditures jump, as state highway departments have boosted their road-building activities to new highs. Fiscal 1960 will see the Fund fall $900 million into the red, and 1961, $1 billion more.

The Budget Bureau would like to forestall this trend. Last month Director Maurice Stans conjectured that a boost in the federal gasoline tax might be in order. Consensus is that the deficit will be made up from general appropriations, instead.

* * *

The Corps of Engineers' controversial requirement for 80 ft of clearance under bridges over the Atlantic Intracoastal Waterway will stick. Highway engineers in the states affected have been campaigning for a reduction. Lowering the standard to 55 ft, they say, would save thousands of dollars in highway bridge construction costs. Maj. Gen. E. C. Itschner, chief of the Corps, believes that semi-high, movable spans would be a good compromise. But the federal Bureau of Public Roads will not approve such structures on interstate routes because of the delays to highway users.

This month the Corps will announce results of its significant test of asphaltic concrete as an airfield pavement. A specially constructed test strip on a Mississippi air base has been subjected to thousands of simulated B-52 bomber landings and take-offs. The load on the pavement has been 27 tons per wheel, or 266 psi. Congress ordered the test after conflicting testimony on the suitability of asphalt for heavy bomber runways and taxiways.

Electronic computer programs for bridges and highways are available from the Office of Operations, U.S. Bureau of Public Roads, Washington 25, D. C. The Bureau has assembled these programs—some of them developed by consulting engineers and some by state highway departments—for determining earthwork quantities, design of continuous steel beam bridges, traffic assignments, and numerous other programs.

* * *

A low bid of $5,874,645 has been received from C. J. Langenfelder & Son, of Baltimore, Md., for grading and drainage on the new Washington, D. C., International Airport, the nation's newest complete air facility. The big project will require movement of 8,500,000 cu yd of earth and installation of 11 miles of drain pipe.

For strength and availability you

can count on USS Structural Steel

Steel is the ideal bridge-building material. It has a long history of proven dependability, it's a familiar material that designers and erectors like to work with, and it's *versatile*.

Steel can be welded, flame-cut, riveted, bolted. It can be shop-fabricated, easily shipped to the construction site, and quickly erected in any season. And no other construction material can even come close to steel's combination of strength and impact resistance. In short, there is practically no job you can't do *better* with the wide range of carbon, high strength, and alloy constructional steels available.

Because of the obvious advantages of steel bridge construction, it is fortunate U. S. Steel had the foresight years ago to plan greatly expanded facilities to manufacture structural shapes and plates. These facilities are now in production, and more are on the way to meet the swelling demand of the Interstate Highway Program.

In view of these growing facilities, you can confidently design bridges with steel—the material you know the best, the material that offers the most—knowing it will be available when needed.

So remember—no matter what kind of bridge you design, *you can count on steel.*

The bridge illustrated above was designed by the Texas Highway Department. Gulf Bituithic Company, Contractor.

USS TRADEMARK

United States Steel Corporation – Pittsburgh
Columbia-Geneva Steel – San Francisco
Tennessee Coal & Iron – Fairfield, Alabama
United States Steel Supply – Warehouse Distributors
United States Steel Export Company

United States Steel

KEEP OUR ROADS ON THE GO

NEWS BRIEFS . . .

Prestressed Concrete Studied at Chicago Meeting

Technical problems involved in making better prestressed concrete vied with handling finished products, satisfying architects with appearance, and advertising for new markets as principal themes of the Prestressed Concrete Institute's fourth annual meeting held in Chicago late in September. More than 700 working men in this relatively new field attended the week-long sessions to hear panels of their associates give details of successful, and unsuccessful, things they have tried.

That prestressing is a new field is indicated by an average age of those attending of some 10 to 20 years less than for meetings of many groups in allied fields. These younger men sometimes represented lusty offshoots of prosperous companies diversifying for the future. But many are swinging a new business on a shoestring. They found it especially profitable to exchange ideas on how to do things.

The exchange of ideas included practically everything. In general, the competitive area for any prestressing business is small, limited by transportation costs so few were keeping secrets for possible competitive advantage. The Ben Gerwick organization, for example, which serves a large area of California from waterside plants on San Francisco Bay, had men on several panels to tell others about technical advances, transport ideas and how to sell—drawing on their experiences as a pioneer in precasting and prestressing.

Plant Standards

Concern for a more uniform product was shown in a proposal from within the organization to establish minimum standards for prestressed concrete plants. A committee has worked out tentative standards to cover materials, equipment, personnel, design and manufacturing techniques in both pre- and post-tensioning. It is estimated that the cost will be about $1,750 a year per plant for inspection for certification. An equal amount will be needed from each for advertising promotion of the use of material from certified plants.

Small operators feel this cost of certification is high. Some architect-engineer firms think they will still require their own inspection. The idea will be presented by letter to the 260 plants currently prestressing structural members. When enough agree, certification of plants probably will be started. The cost of small-plant certification, necessarily about the same as for large plants, is expected to be a delaying factor.

Good Concrete

A most important item in establishing quality concrete is a laboratory at the plant, according to several panelists. Another is organization, as careless workmanship may leave defects that show up in the finished structure but cannot be found by visual inspection.

Good appearance is paramount. The architect and owner are concerned primarily with that—strength is the engineer's problem. Differential camber came in for considerable discussion, but no solution. One suggestion that had considerable support is getting architects to design so that a modest differential elevation in beam bottoms is acceptable.

The 28-day strength of prestressed concrete generally is academic. The usual requirement of 5,000 psi is normally exceeded by provision for getting 3,500 to 4,000-psi concrete in a few hours to permit tension release and moving out of the casting bed. This is accomplished by use of high early strength cement and 140 to 160-deg steam curing. Discussion brought out that Type III (high early strength) cement generally is preferred by prestressed concrete fabricators. A few buyers, notably the State of Illinois, have had bad experience with Type III and insist on Type I cement.

Most panelists agree that the fabricator should keep control of the members to final position in the building. They recommend that the transport and erection be done by a fully controlled subsidiary rather than by plant personnel, because of differences in insurance, wage scales, and working regulations.

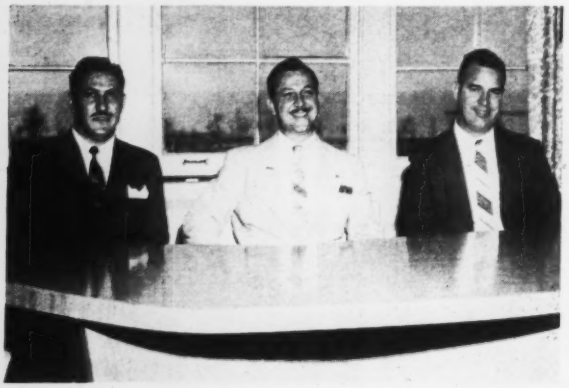
Powerful handling equipment to move heavy beams from the storage bed and into and out of storage is a problem, especially for the small operators. Straddle trucks are now extensively employed in the precasting yards. One operator warns not to let a beam tip over on soft support in the storage area. It can tie up access for some time in an area where the straddle truck access is blocked and no provision is made for crane movement. Some smaller plants use cranes that can be adapted to erection, but the consensus of the panel was that plants must operate constantly to be profitable, so dual use is not practical.

Stress and Sell

"The sky is the limit," Charles Luckman, of Perriera & Luckman, told the Prestressed Concrete Institute in the keynote address. The first thing is to think of prestressed concrete as a new material, rather than as a new use for ordinary reinforced concrete. The manufacturer of concrete products must be market-minded. Mr. Luckman suggested a new slogan for the group, "sell and stress—sell the stressing and stress the selling."

Following the same theme, Jackson Taylor of Lennen & Newell, a New York City advertising agency, told the Institute that he had started to talk about prestressed concrete to 35 leaders of industry and found that none had ever heard of it. He pointed out the immediate necessity for advertising, so that when engineers, architects, and manufacturers are talking with owners about prestressed concrete they will be familiar with the product. He quoted an economist as predicting that, "during the coming decade new construction expenditures will just about equal the present depreciated value of all private structures—homes, office buildings, factories, etc.—standing in the United States today."

This most informative program was arranged by Charles C. Zollman, M. ASCE, consulting engineer of Newtown Square, Pa., as program chairman for the meeting.



New officers for Prestressed Concrete Institute are (in usual order) Philip E. Balcomb, vice - president; Peter J. Verna, Jr., A.M. ASCE, president; and J. O. Whitlock, secretary-treasurer.

New Officers Chosen

Ben C. Gerwick, Jr., M.ASCE, of San Francisco, handed the presidential gavel over to Peter J. Verna, Jr., A.M. ASCE, of the Concrete Materials Co., Charlotte, N. C., former secretary-treasurer of the organization. Philip E. Balcomb, of the American-Marietta Co., La Grange, Ill., succeeded Harold A. Price, of Napa, Calif., as vice-president. J. O. Whitlock is the new secretary-treasurer. A. H. Gustaferro, A.M. ASCE, is program chairman for the next annual meeting, which will be held at Miami, Fla.

Investments Abroad Total $37 Billion

In 1957 private investors in the United States had nearly $37 billion in foreign investments. This was up nearly $4 billion from the preceding year. More than $3 billion was invested in foreign subsidiaries and branches of United States companies, reflecting expansion to meet the expected long-run demand for basic materials and to supply foreign markets. Other private capital investment during the year mainly represented purchases of foreign dollar bonds and a rapidly expanding volume of commercial bank loans.

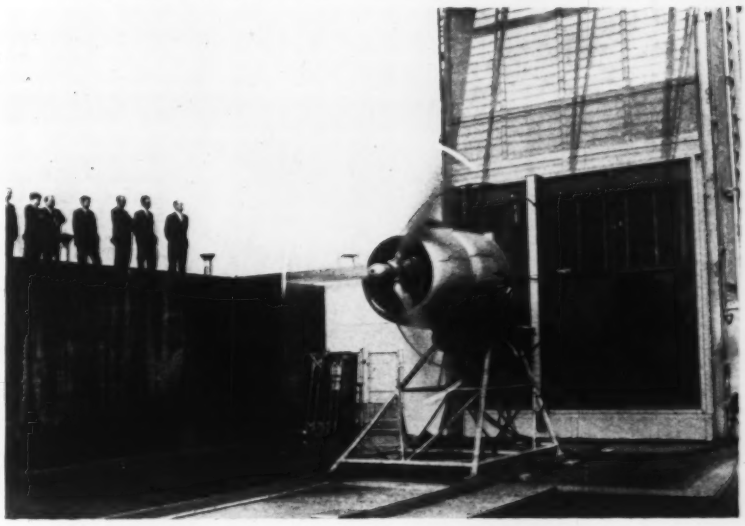
Latin America leads in the flow of private capital, with an increase of over $1.3 billion in 1957 over the preceding year. Total investment south of the border now exceeds $8.8 billion, of which $3.2 billion is in petroleum, $1.7 billion in manufacturing, $1.2 billion in mining and smelting, and $1.3 billion in public utilities. More than $900 million was added to petroleum investments in Latin America, with Venezuela accounting for $770 million. The Canadian investment was also large, with additions of $870 million made in direct investments. The outflow to Canada for most industries was also substantial, but only in petroleum was the 1956 total exceeded.

These figures are reported by the office of Business Economics of the U.S. Department of Commerce.

Kansas Turnpike Revenues Pick Up

Kansas Turnpike traffic and revenue tolls increased in August for the third consecutive month, according to the Kansas Turnpike Authority. Even more satisfactory to turnpike officials, it was the first month since the turnpike opened that revenues met both operating costs and interest requirements, with a surplus of about $14,000 available for sinking fund purposes. The August toll revenue was $479,224, up almost 16 percent from August 1957 tolls and almost 11 percent above July 1958, the previous peak in the 22-month period of turnpike operations.

Stand-in for New Time and Life Building



Dynamic weather test is performed on 15 x 15-ft mock-up of the facade of the new Time & Life Building, which is being erected in mid-town Manhattan. The tests, conducted at the General Bronze Corporation's Garden City plant, were designed to check materials and design details for the new curtainwall structure to assure a weathertight installation even in heavy rainstorms and high winds. Representatives of Rockefeller Center, Inc., the George A. Fuller Company and John Lowry, Inc. (the contractors), and General Bronze watch the tests that simulated 4-in. rains and winds up to 130 mph. A 1,200-hp airplane engine with 10-ft-dia propeller placed 19 ft from the face of the mock-up supplied wind pressure for the tests. Water was applied into the air slip-stream from an overhead sprinkler system. Steel work for the 48-story skyscraper is now 90 percent completed, with topping-out scheduled for early November. Occupancy is expected in the fall of 1959.

Mexico Hit by Floods

The worst rains in eighty years have plagued Mexico this rainy season, leaving in their wake many dead and over 40,000 homeless. The Communications Ministry reports serious damage to roads and bridges in all parts of the country. Especially hard hit are the states of Chihuahua, Coahuila, Guanajuato, Jalisco, Nayarit, Nuevo Leon, and Sinaloa.

In Mexico City the situation is complicated by the fact that many areas are sinking, thus preventing natural drainage. Some of the poor residential districts were flooded with sewage, when flood waters knocked out a pumping station and reversed sewage flow through the gravity mains. The sewage back-up also broke the walls of the Gran Canal, a huge open sewer that is one of the principal interceptors for the city.

While a new sewer system cannot be built until the city stops sinking, engineers will take various remedial measures. Immediate plans call for repairing and strengthening the walls of the Gran Canal and installing two new pumping stations. The long-range plan calls for a $5,000,000 second-stage pumping station to be built on higher ground. Ultimately, it is hoped, the unsanitary open canal can be replaced by a closed interceptor system.

Allis-Chalmers Expands Its Research Facilities

The Allis-Chalmers Manufacturing Co., of Milwaukee, Wis., has completed construction of new engineering, development, and research facilities in Greendale, Wis., a Milwaukee suburb, near the company's West Allis works. The new facilities, which include two buildings and provide about 23,000 sq ft of space, will house some 200 engineers, scientists, and technicians. Projects to be carried out in the up-to-date center will include the design, construction, and testing of models, mock-ups, and prototypes of nuclear reactors and associated equipment.

Walt Whitman Bridge, Philadelphia, which receives the Class I Award (for bridges with spans of 400 ft or more) is cited for "the lacy appearance of the bridge deck [that] contrasts dramatically with the solid towers." Owner: the Delaware River Port Authority; designers: Modjeski & Masters and Ammann & Whitney; fabricators: the Bethlehem Steel Company, the American Bridge Division of U.S. Steel, and the New York Shipbuilding Co.

General James Longstreet Memorial Bridge, Gainesville, Ga., is winner of the Class II Award for bridges with fixed spans under 400 ft and costing more than $500,000. The jury commented on "its sensitive design." Owner: the Corps of Engineers for the State of Georgia; designer: Patchen & Zimmerman; fabricator: the American Bridge Division.

Most Beautiful Steel Bridges Opened to Traffic in 1957

In the recent Annual Aesthetic Bridge Competition, sponsored by the American Institute of Steel Contruction, fourteen structures in eleven states were chosen as the most beautiful United States bridges opened to traffic in 1957. There were 81 entries, the largest in the 30-year history of the competition.

Stainless steel plaques will be affixed to the four prize-winning structures, and honorable mention certificates will be awarded to the designers, owners, and fabricators of the other ten bridges. Photos of the four top winners are shown here.

Honorable Mention

The **Certificates of Honorable Mention** (for the first named in each class) were awarded to the following:

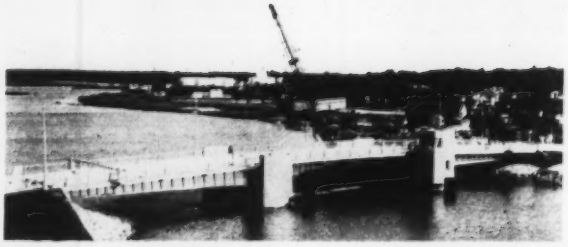
Class I: La Conner Bridge, Skagit County, Washington. Owner: Skagit County; designer: Harry R. Powell and Associates; fabricator: the United Concrete Pipe Products Company.

Class II: Trinity River Bridge, Hoopa, Calif. Owner: State of California; designer: the Bridge Department of the California Division of Highways; fabricator: the American Bridge Division of U.S. Steel.

Class III: Shell Road Ramp Bridge, south approach to Baltimore Harbor Tunnel. Owner: Maryland State Road Commission; designer: Whitman, Requardt and Associates; fabricator: the American Bridge Division of U.S. Steel.

Class IV: Robert Craig Memorial Bridge, Toledo. Owner: City of Toledo; designer: Howard, Needles, Tammen & Bergendoff; fabricator: the Fort Pitt Bridge Works.

Hampton Road Overpass, Dallas, Tex., receives the Class III Award for bridges under 400 ft and costing under $500,000. The jury approved its "clean looks and graceful arch." Owner: the Texas Turnpike Authority; designer: Powell & Powell; fabricator: the Mosher Steel Company.



Madison-Monroe Street Bridge, Two Rivers, Wis., is winner of the Class IV Award for bridges with movable spans. The jury praised the placement of the operator's control room in the background of the structure. Designer: Hazelet & Erdal; fabricator: Lakeside Bridge & Steel Company.

Another Skyscraper Goes up in New York City

The Manhattan skyline will be ornamented by another skyscraper—the First National City Bank's 41-story office and bank building, which will rise on Park Avenue between 53rd and 54th Streets. The 515-ft skyscraper, featuring a tower and setbacks, will have over 1,500,000 sq ft of floor space. Exterior face will be of glass and aluminum, with the structural columns covered with a light gray limestone bound with metal. Separating the large plate-glass panels, which will substitute for windows, will be extruded mullions of natural-colored aluminum. Completion of the $50,000,000 skyscraper is set for early in 1961. The George A. Fuller Co. will erect the building from designs by Carson & Lundin and Kahn & Jacobs, associate architects. Charles Mayer is the structural engineer, and Meyer, Strong & Jones the mechanical engineers.

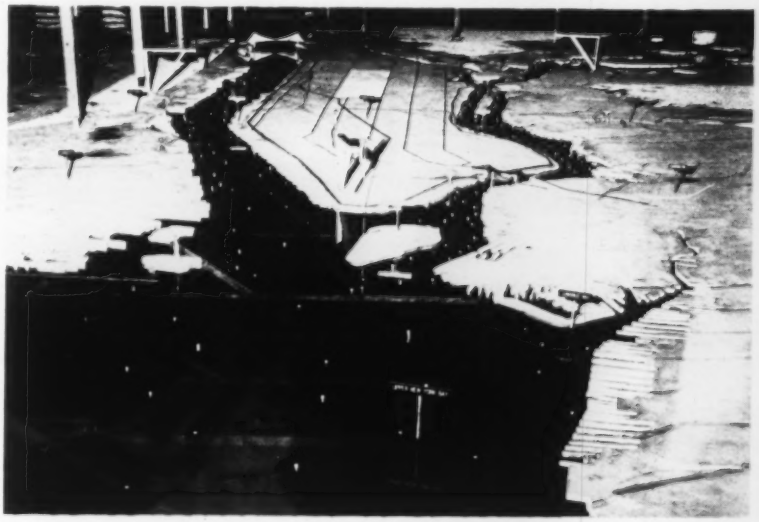
Housing Starts Rise Seasonally in August

Nonfarm housing starts rose seasonally in August to 119,000, compared with 111,000 in July and 100,000 in August 1957, according to preliminary estimates of the U. S. Labor Department's Bureau of Labor Statistics. The 7 percent advance was mostly in public housing. Privately owned housing starts edged up a little over the year's previous high in July, to 108,800—12 percent above a year earlier and the best monthly figure in more than two years. The increase over the month and over the year was all in housing begun with government-backed mortgage assistance.

On a seasonally adjusted basis, private starts in August were at an annual rate of 1,170,000—the highest since January 1956, and 28 percent above the nine-year low of last February. When averaged for the first eight months, the 1958 rate was 1,037,000 units, compared with 982,000 in 1957.

This year's private housing total (717,300 units) was up 6 percent from 1957 because of the sharp rise in FHA-assisted starts and steadiness in conventionally financed housing. On the basis of building-permit reports, all sections of the country except the New England and North Central States are showing strength in private housing this year, compared with 1957. The eight-month total of publicly owned housing starts was at a seven-year high of 50,700 units in 1958, compared with the 35,400 reported in the same 1957 months. The public total was boosted by a substantial amount of housing begun for the armed forces as well as gains in federally-aided low-rent housing.

Model Set Up for New York Harbor Siltation Study



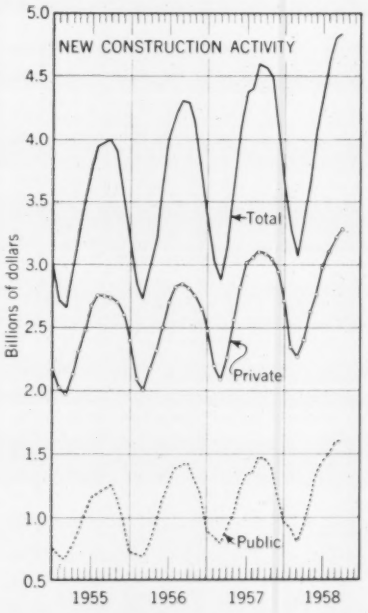
Panorama of New York Harbor as set up at the Waterways Experiment Station, Vicksburg, Miss., shows Upper New York Bay (lower center); East River, Manhattan Island, Hudson River (upper center); and Upper Hackensack River (left background). Model is constructed to distorted scale of 1 to 100 vertically and 1 to 1,000 horizontally. It will be used to develop plans to alleviate shoaling in Hudson River ship channel and in pier slips on New York and New Jersey shores of Hudson River. Col. T. DeF. Rogers, district engineer of U. S. Army Engineer District, New York, invites those interested in viewing recently constructed hydraulic models of Hudson River and Troy Lock and Dam to contact Technical Liaison Branch, in Colonel Rogers' office at 111 East 16th Street, New York City. Arrangements for inspection at Vicksburg can be made through Colonel Rogers' office. Siltation testing program for Hudson River Model is now underway.

September Construction Activity at August Level

New construction activity in September matched the all-time high of $4.8 billion set in August, according to preliminary joint estimates of the U. S. Departments of Commerce and Labor. The total dollar volume for the first nine months of 1958, estimated at $36.4 billion, was up slightly from the comparable 1957 period.

Public construction thus far in 1958 was stimulated by increased spending for highways and public-housing programs (including armed services and low-rent housing), and totaled $11.3 billion—a rise of 6 percent from the first nine months of 1957. The private construction total, at $25.1 billion, was only slightly below the total for the same 1957 period, with gains in housing and most types of non-residential construction almost offsetting the sharp drop in industrial building.

These monthly estimates are determined primarily by past contract award movements, standard progress patterns, and assumed normal seasonal movements. Except when special surveys are made, the estimates do not reflect the effects of varying numbers of working days in different months, nor of special conditions influencing the volume of activity in any given month. General indicators of future trends in activity are housing starts, contract awards, building permits, and materials output. Analayses of trends of activity should consider all these interrelated factors.



September construction activity, at $4.8 billion, matches all-time high set in August. Total first nine months is up slightly from last year.

Lincoln Electric Builds New Plant in Australia

The Lincoln Electric Company of Cleveland, Ohio, announces that its Australian subsidiary, the Lincoln Electric Company (Australia) Pty. Ltd., is building a new plant in Sydney for the manufacture of arc-welding equipment and supplies. Modeled after the company's Cleveland plant, the new building will be completely windowless and fully air conditioned. The 445 x 300-ft plant is laid out so that materials handling will be reduced to an absolute minimum. Raw materials and work-in-process will be stored at the point of next use, rather than in a central storage area. The new plant is located on a twenty-acre plot in Alexandria, a suburb of Sydney.

Largest Power Output

The American Electric Power Company, with a total generating capacity of 5,113,000 kw, is the first electric power company in the world with a capacity in excess of 5,000,000 kw. This new peak output was achieved with recent opening of the 225,000-kw Unit 1 at the Clinch River Plant at Carbo, Va. A second generating unit of the same capacity is scheduled for completion in November. Construction of the $60,000,000 plant was started in 1956. The plant is owned and operated by the Appalachian Power Company, one of six operating companies of the AEP system.

Philip Sporn, M. ASCE, is president of both the AEP and the Appalachian Power Company.

U.S. Steel Expands Its Corrosion Study Program

A new corrosion study program has been established by the United States Steel Corporation in eight cities—Washington, New York, Chicago, Seattle, San Francisco, Los Angeles, Houston, and Birmingham. Variety of climate, geographical distribution, and atmospheric conditions are some of the factors determining the choice of these localities.

The new studies will augment a program which, in the past thirty years, has led to the exposure of more than 30,000 specimens of 850 different steels. At the present time U.S. Steel scientists are exposing 8,360 specimens at the company's research center at Monroeville, Pa., and at Kure Beach, N. C., where marine specimens are tested, and Newark, N. J., for industrial testing.

Joint Pollution Study

Pennsylvania and New York are cooperating in a joint interstate study on sources and control of water pollution on streams crossing their common boundary. In announcing the study C. L. Wilbar, Jr., Pennsylvania State Secretary of Health, remarked that the program, in which Pennsylvania and New York State sanitary engineers will cooperate, "is the latest example of the fact that, when it comes to keeping streams free of pollution, neighboring communities and states must share the responsibility."

The joint study will deal with the Chemung River. Similar joint action has already been taken on the Allegheny, the Susquehanna, and the Delaware.

AGC Selects New Officers

James W. Cawdrey, Seattle contractor has been nominated for president and John A. Volpe, former Federal Highway Administrator, for vice-president of the Associated General Contractors of America. Mr. Cawdrey, now vice-president of the AGC, is a member of the Seattle building firm of Cawdrey & Vemo. He will succeed the current president, Fred W. Heldenfels, Jr., of Corpus Christi, Tex. Mr. Volpe, who served as Federal Highway Administrator on an interim basis to launch the nation's long-range highway program, is head of the John A. Volpe Construction Company, of Malden, Mass.

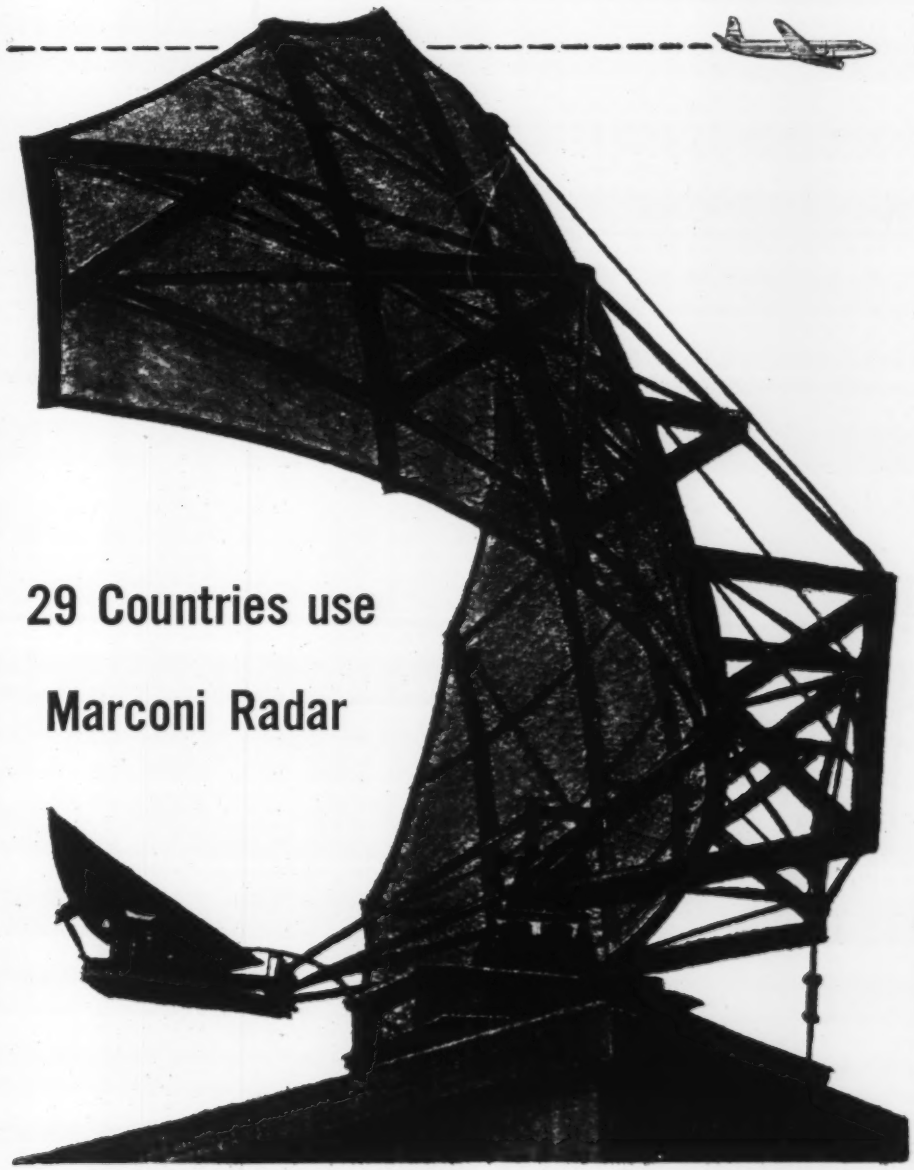
The AGC election will be conducted by mail ballot in December, and the new officers will be installed at the fortieth annual convention of the AGC, to be held in Miami Beach next January.

Concrete Industry Board Elects Officers for 1959

The Concrete Industry Board announces the election of officers for the forthcoming year. The new president is George N. Cohen, president of the Euclid Contracting Corp., which is currently building New York City's new Guggenheim Museum, designed by Frank Lloyd Wright. Also elected were Nelson L. Doe, vice-president; William J. McIntosh, secretary; and Dugald J. Cameron, A.M. ASCE, treasurer.

Emil Praeger, M. ASCE, partner in the New York City civil engineering firm, Praeger-Kavanagh, will represent the Metropolitan Section of ASCE on the eleven-man board of directors. Admiral J. J. Manning, M. ASCE, is managing director of the association, which was set up six years ago with the aim of improving concrete construction.

Marconi in Radar



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Of the 253 bridges on the new highway, 241 have aluminum railings. One span, the East-West Tri-State Congress Street Tri-Level Interchange, has 19,000 feet of Alcoa 1014 and 3001 railing.

For highway programs in every forward-looking state, Alcoa Aluminum is stretching taxpayers' dollars. With strong, handsome, maintenance-free aluminum, you can install it and forget it. For more information on aluminum bridge structures, railings, highway signs, lighting standards, gratings, overhead sign structures, chain link fencing and other highway applications, call your nearest Alcoa sales office. Or write: Aluminum Company of America, 1979-L Alcoa Building, Pittsburgh 19, Pa.

Alcoa 1014 Type B Bridge Railing being installed. Type B was developed by Alcoa, working with Consulting Engineers Joseph K. Knoerle & Associates, Inc.

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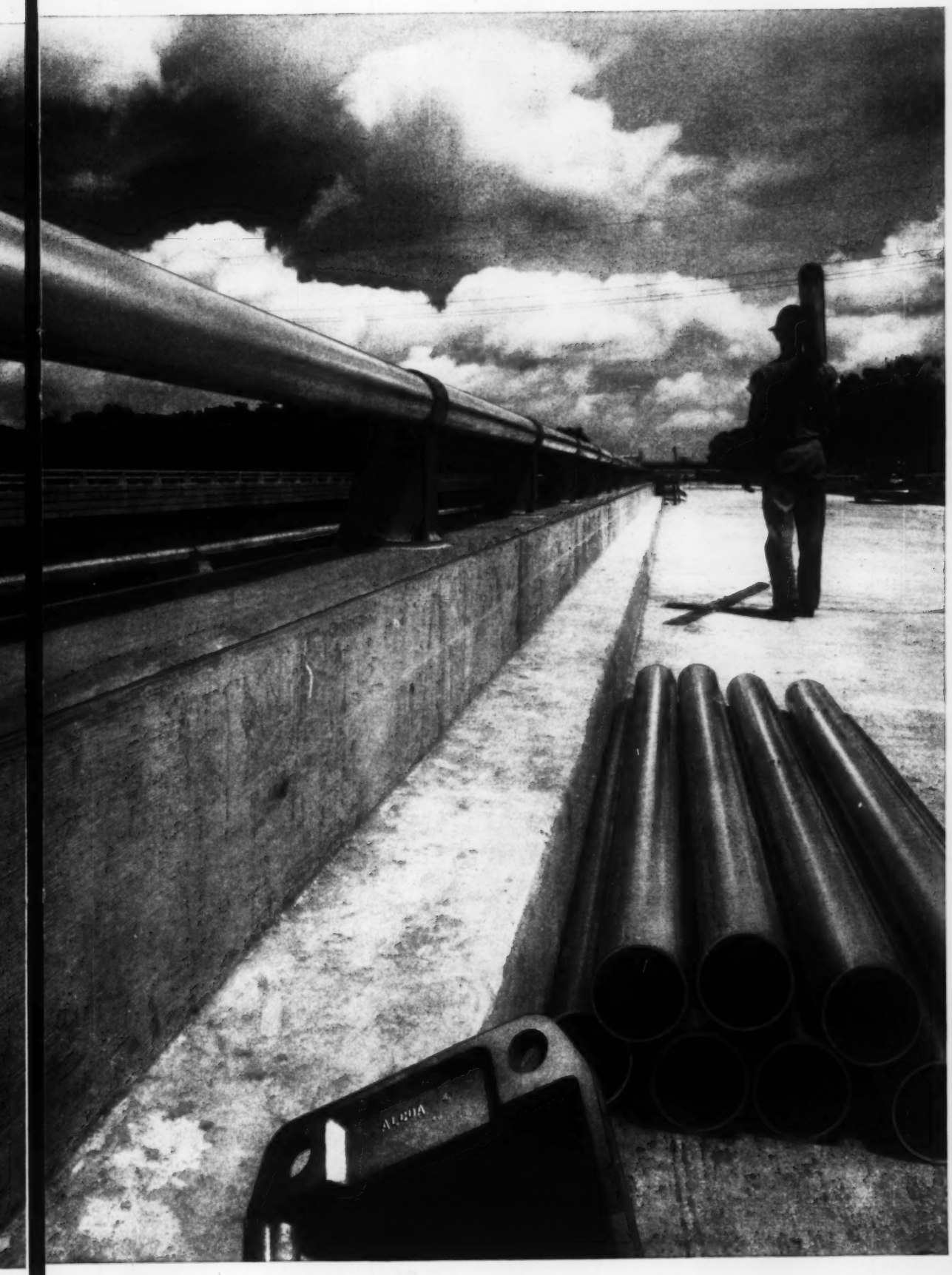
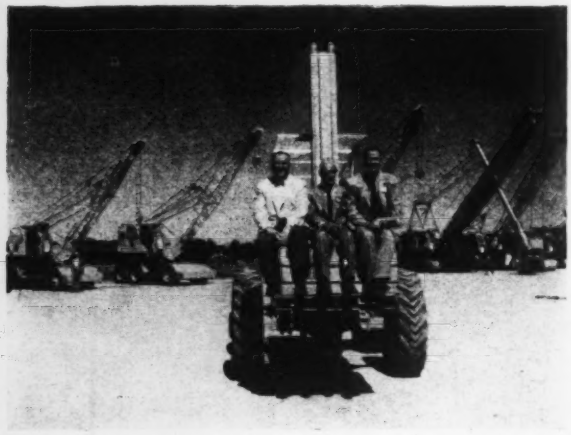




Million-Dollar Display of Equipment

New Hi-Lift fork truck designed for construction use takes Julien R. Steelman (center), president of the Koehring Company, for a ride at recent Koehring equipment show in Milwaukee. Flanking Mr. Steelman are Lester Olsen (left), president of the Milwaukee Chamber of Commerce, and Charles F. Jones, Milwaukee banker. At the show a million dollars worth of newly developed and improved machines were on display for contractors. Koehring devotes 3 percent of its sales income to research. This has paid off, as Mr. Steelman reported that two-thirds of its dollar volume last year was from products developed in the past ten years, and that volume has risen from $16 million in 1947 to $55 million in 1957.

N. G. Neare's N* COLUMN

R. ROBINSON ROWE, M. ASCE

"Did I copy the problem wrong, or was it really easy?" asked Joe Kerr.

"Might be both," mused Professor Neare. "Quintus left Antiguus all of a pentagonal farm except for the largest square that could be described in it, to Brutus all of the square except for the largest regular triangle which could be described therein, and the triangle went to Cassius."

"Then I got it! From this chart (Fig. 1*a*) of the subdivision, letting p, s and t be the sides of the pentagon, square and triangle, respectively:

$$p = \frac{1 + \frac{1}{2}\sec 18°}{1 + 2 \sin 18°} s = 0.943s \quad . . . . (1)$$

$$t = s \sec 15° = 1.035s \quad . . . . . (2)$$

and then it was elementary geometry to compute all areas in terms of s. Antiguus kept 34.63 percent, . . ."

"Oh no he didn't," interrupted Cal Klater. "The man said, 'the largest square,' and that's laid out (Fig. 1*b*) with one corner at a vertex of the pentagon and the opposite corner not quite touching the opposite side of the pentagon. Joe's second equation is right, but instead of the first,

$$p = s \sec 18° \cos 27° = 0.9368s \quad . . . (3)$$

Then the area of the pentagon is $1.5099s^2$, and of the triangle, $0.4641s^2$, so that the respective shares of the heirs were 33.78 percent, 35.49 percent and 30.73 percent of the farm. You asked how equitable the division was, so I should add that the smallest share has the best shape."

"And I can add in answer to Joe's second question that the problem is easy if you know how to orient the square. One other possibility had to be considered—one corner of the square at the midpoint of a side of the pentagon, for

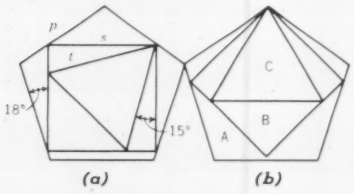


Fig. 1. Cutting a square from a pentagon, Joe laid it straight, but Cal made it diagonal.

which p=0.955s. Now, for a new assignment, I'd like to call on Guest Professor Kum Pewter who hopes to confuse you with his magic cubes."

"My cubes (Fig. 2) are magic in two ways," claimed Professor Pewter. "First is the way familiar to all of us, that as we look at the isometric of three cubes, they suddenly fade out and we see three other cubes. The second way is in the numbers from 1 to 13 which I want you

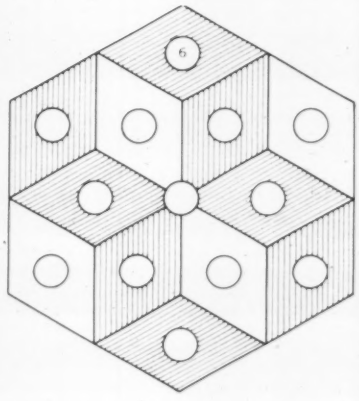
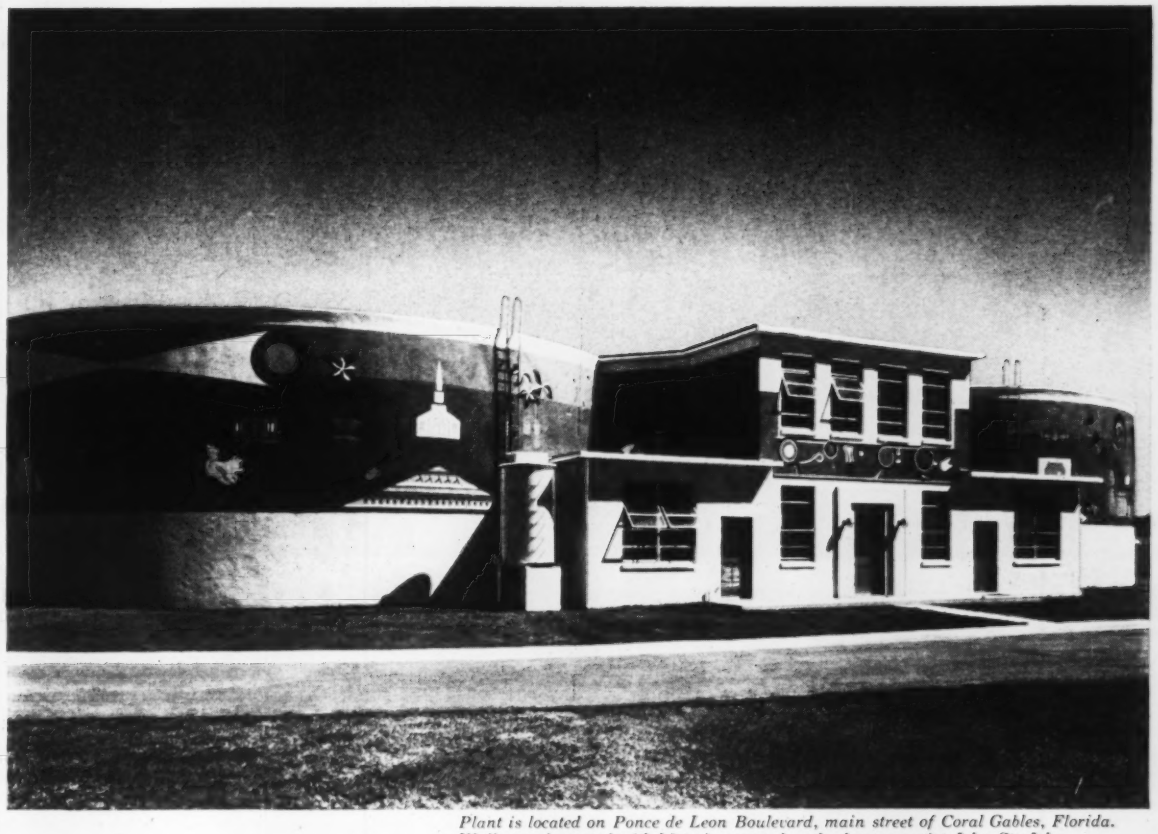


Fig. 2. Magic cubes ready for new magic.

to put in the 13 circles. Each of the six cubes has four circles, including the central circle common to all, and the four numbers on each cube must add to 27. So that our answers will look alike, let's put the number 6 in the top circle."

[*Cal Klaters were: Del Awarun (George N. Hyland), Jimmie M. Alford, Ad L. Pate (Grover H. Wilsey), T. N. Anand, and David V. Messman. Also acknowledged are correct solutions of the August problem from Messman and Emerson Boyd Jr. Guest Professor Kum Pewter is Walter Steinbruch.*]



Plant is located on Ponce de Leon Boulevard, main street of Coral Gables, Florida. Walls are decorated with historic scenes done by famous artist John St. John.

In Coral Gables, Florida . . . . .

modern concrete made this sewage treatment plant a good neighbor

A handsome addition to the city, this plant will cause no loss in property values.

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Concrete used this way can be beautiful as well as practical. In Coral Gables, the sewage treatment plant is almost a civic show place.

Construction costs with concrete are moderate—and upkeep expense is always low. This is one material that can't rust, rot or burn. It lasts a lifetime. When America builds for beauty . . . it builds with modern concrete.

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Engineers, Coral Gables project: Smith and Gillespie, Jacksonville, Florida. Contractor: Markowitz Co., Coral Gables, Florida.

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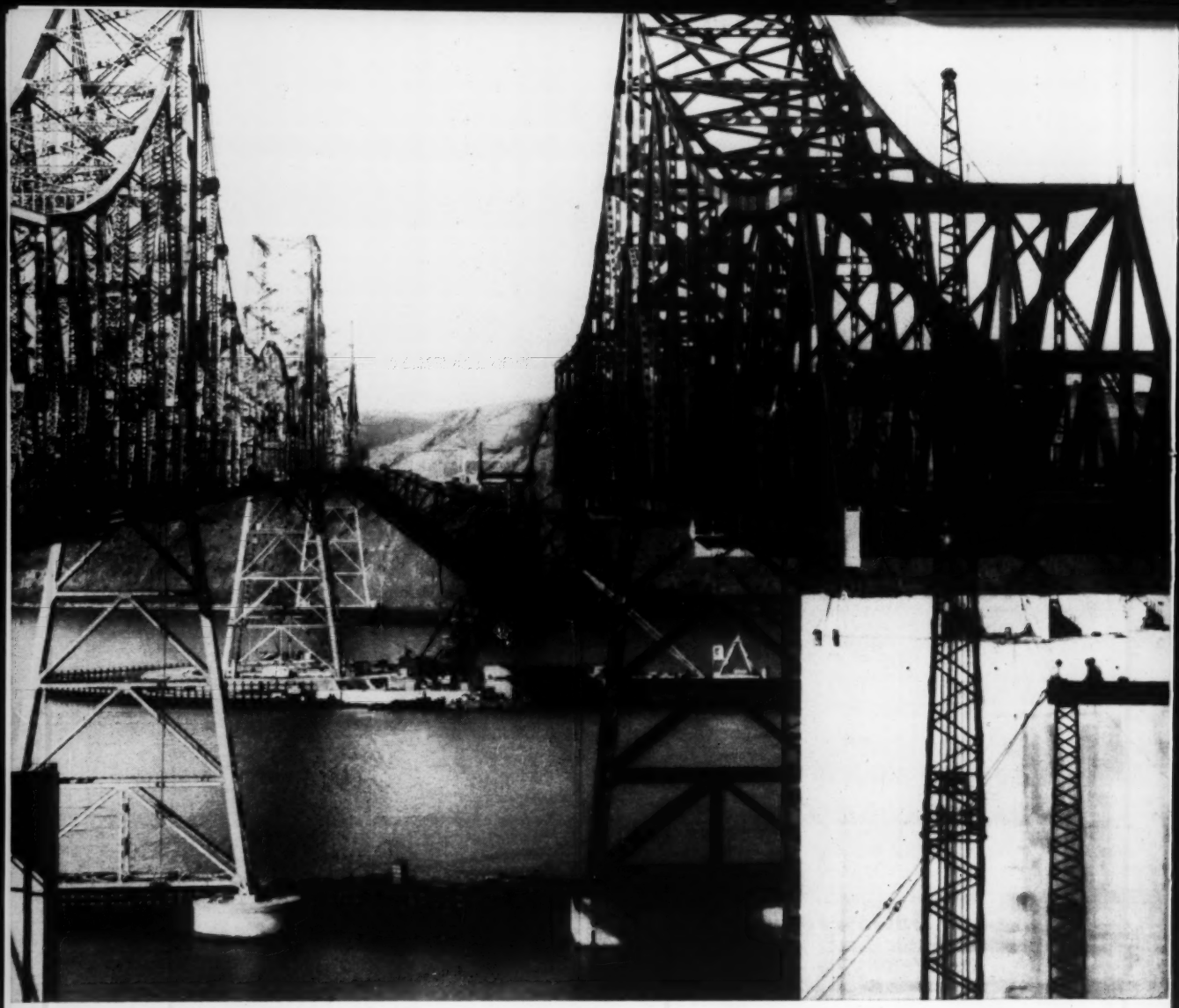
A national organization to improve and extend the uses of concrete

MODERN concrete



USS "T-1" Steel Plate now furnished to 100,000 psi minimum yield strength

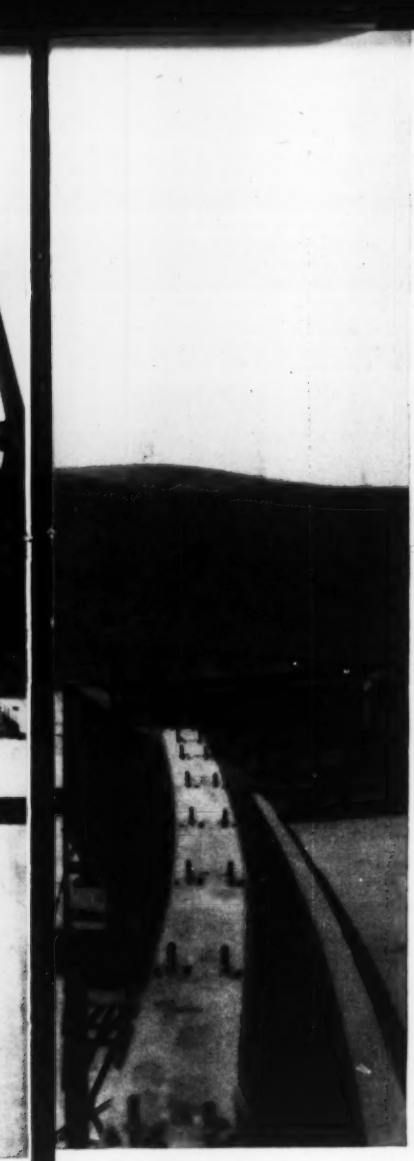
11% greater strength. USS "T-1" Constructional Alloy Steel can now be furnished to a minimum yield strength of 100,000 psi in plates up to 2½ inches thick. This is in addition to the present types of "T-1" Steel which are still available at a minimum yield strength of 90,000 psi. The new minimum tensile strength—the point at which actual breakage occurs when stressed in tension—has been increased from 105,000 to 115,000 psi. The published tensile strength maximum of 135,000 psi remains unchanged.

Weight reductions up to 50%—or more. Because of its great yield strength, three times that of structural carbon steel, USS "T-1" can be used to save weight in highly stressed members of bridges, TV towers and pressure vessels. Weight savings from 25 to 50% are common. For construction equipment, USS "T-1" Steel's strength, plus high resistance to impact abrasion, boosts payload capacity and increases equipment life.

Cost savings up to 11%. The increase in strength at no extra cost amounts to customer cost savings up to 11%. Use of higher design stresses reduces the fabricating, welding and shipping costs because less material is needed.

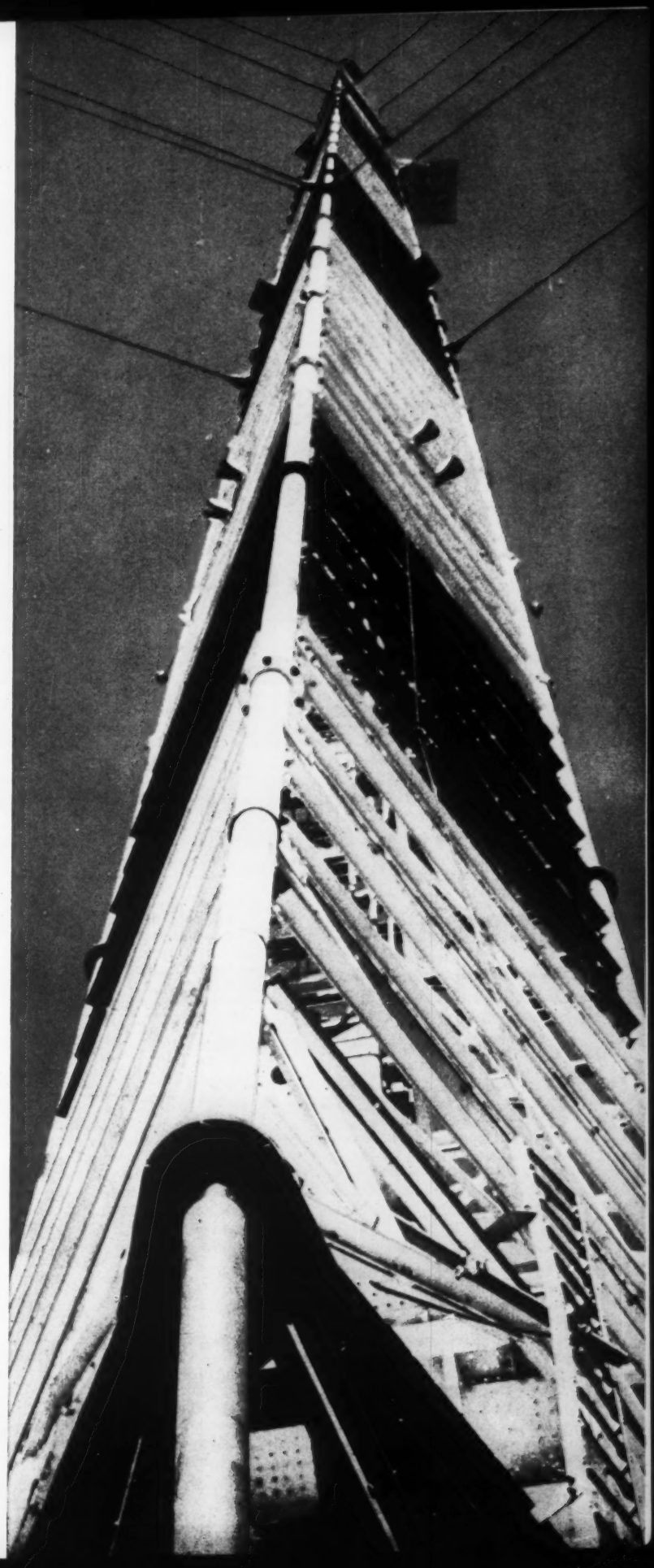
The new strength data were arrived at after continuous tests on production lots of USS "T-1" Steel Plates at our Homestead Works. Actual experience confirmed the tests, and it became apparent that higher mechanical properties inherent in USS "T-1" Steel could be consistently developed. **Free book.** For complete technical information on USS "T-1" Steel, write to United States Steel, Room 2801, 525 William Penn Place, Pittsburgh 30, Pa.

USS and "T-1" are registered trademarks



USS "T-1" Steel saves $800,000. By using this stronger, weldable steel in the heavily stressed members of the New Carquinez Bridge in San Francisco, weight of some members was cut almost in half, with an overall savings of $800,000.

TV tower costs cut 15%. Because of its great strength, USS "T-1" Steel was used in the bottom 838 feet of this 1,199-foot TV tower. The cross-sectional area of the legs was reduced by 44%, resulting in a material and fabrication saving of 15%.



USS

United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Supply—Steel Service Centers
United States Steel Export Company

United States Steel

NEWS OF ENGINEERS

(*Continued from page 26*)

W. G. Huber has taken the position of chief engineer for the Development and Resources Corporation at Ahwaz, Iran. Since 1954 Mr. Huber has been with the B. C. Engineering Company, Ltd., in Vancouver, B.C.

C. E. Wheeler

Charles E. Wheeler has been named general manager of the Arizona Testing Laboratories with headquarters in Phoenix. Mr. Wheeler will supervise the main laboratories and executive offices in Phoenix and the branch facilities at Tucson and Flagstaff. Before his promotion, he was manager of the Tucson branch.

Arthur W. Harrington, district engineer for the U.S. Geological Survey for more than 35 years at Albany, N. Y., received the Distinguished Service Award of the Department of the Interior, the highest honor the department can bestow, at ceremonies held in Washington, D. C., on September 5. Mr. Harrington retired from the Survey last June after nearly 43 years of federal service. He now lives at 320 Elmwood Ave., Ithaca, N. Y. Mr. Harrington has served the Society as Director and Vice President and was chairman of the special committee that revised the Constitution and By-Laws.

Randolph H. Dewante announces the relocation of the sanitary and civil engineering consulting office of Dewante and Stowell at 916 21st St., Sacramento, Calif. The firm was formerly located at 2015 J Street in Sacramento.

John B. Howe has been named to the National Panel of Arbitrators of the American Arbitration Association. He will serve in the Los Angeles area. Mr. Howe is a partner in Maurseth & Howe, Los Angeles consulting foundation engineers.

Robert A. Williamson has been promoted to the recently created position of chief structural engineer for Holmes & Narver, Inc., in Los Angeles. He was formerly senior structural engineer.

Morton Solomon has joined the staff of Metcalf and Eddy, Boston consulting engineers. Mr. Solomon recently retired from the Army where he was assistant for engineering and contracts for military construction in the Office of the Chief of Engineers. He was awarded an Oak Leaf Cluster to add to the Legion of Merit received for construction during World War II. Facilities constructed under his direction totaled about $1 billion.

Lee H. Huntley is retiring from active practice after a career of more than 50 years spent on the design and supervision of construction, hydroelectric, and irrigation projects, ore mills, and many other projects. Since 1951 he has been chief engineer of the Brazos River Authority at Mineral Wells, Tex.

James M. Rice has been named director of the Natural Rubber Bureau's Research Laboratory, in Washington, D. C. Formerly research and testing engineer for the National Crushed Stone Association, Mr. Rice will head the laboratory which specializes in the development of rubber and asphalt for road use.

C. M. Spofford

Charles M. Spofford has received the Frank P. Brown Medal of the Franklin Institute in Philadelphia. Professor Spofford was honored for "The engineering, aesthetic and educational accomplishments of his life work . . . his contribution to engineering education . . . and his authorship of widely used textbooks." He is professor emeritus of the Massachusetts Institute of Technology and a former partner in the consulting firm of Fay, Spofford & Thorndike, Inc.

Thomas W. Jones has been appointed chief engineer and production manager for the Unadilla Silo Company, Unadilla, N. Y. Mr. Jones, formerly a design engineer with the Chicago Bridge and Iron Company, will supervise design and production of structural glued laminated beams and arches.

Norman H. Brooks has been promoted to associate professor of civil engineering at the California Institute of Technology. Professor Brooks has been on the faculty as an assistant professor.

DECEASED

Chester L. Appleton, Sr. (M. '25), age 74, retired civil engineer, died in Mount Holly, N. J., on August 29. At the time of his retirement in 1950, Mr. Appleton was serving as construction engineer with the Delaware River Port Authority. Among the many large projects with which Mr. Appleton was connected were the Benjamin Franklin Bridge, the 30th Street Station of the Pennsylvania Railway, and the high-speed line between Camden and Philadelphia.

Murray J. Backus (A.M. '16), age 69, project manager and construction engineer for the Public Works Office of the Navy Department in San Bruno, Calif., died there on September 6. Mr. Backus earned his degree at Columbia University and specialized in topographical, drainage, and railway work. As chief civil engineer with the Punta Alegre Company in Cuba for 18 years, he was in charge of all engineering and construction work. He had been in the Public Works Office for several years.

O. G. Bowen

Oliver G. Bowen (M. '25), age 70, senior partner in Bowen, Rule and Bowen, of Los Angeles, Calif., died there on June 3. Mr. Bowen was granted a civil engineering degree from the University of Michigan on the strength of his engineering designs and a treatise on column design. In the course of his long and active career he constructed many bridges and buildings and was active in structural examination and reconstruction planning in the Long Beach earthquake area. The firm which is now Bowen, Rule and Bowen was formed with Mr. Bowen as partner in 1940.

Armstrong Chinn (M. '47), age 63, president of the Terminal Railroad Association of St. Louis, Mo., died there recently. A graduate of the Virginia Polytechnic Institute, Mr. Chinn had spent his entire career in railroad work. He was with the Chicago, Burlington, and Quincy Railroad for over ten years, serving in many different capacities. He had been president of the Terminal Railroad Association since 1946.

Elmer W. Clark (M. '20), age 80, former administrator of the Federal Public Works Administration, died in Leesburg, Va., on August 28. A veteran of World War I, Mr. Clark served as a lieutenant colonel with the American Expeditionary Force in France. In the 1930's he was appointed director of the PWA, eventually rising to the post of administrator. Until his retirement in 1946, he served with the Bureau of the Budget.

C. Irving Colyer (A.M. '12), age 81, retired engineer of Holly Hill, Fla., died there on August 19. A graduate of Rensselaer Polytechnic Institute, Mr. Colyer had done a great deal of work in steel design. He had served as assistant engineer with Westinghouse, Church, Kerr & Company of New York City, designing structural steelwork for the Pennsylvania Railroad Station in New York. With the Electric Bond and Share Company in New York, Mr. Colyer held the position

(*Continued on page 114*)

AMERICAN Fastite® JOINT*
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America's new favorite for water, sewage and other liquid service, American Fastite Joint Cast Iron Pipe — is simplicity itself. With only one joint component — its exclusive double-sealing, *dual-hardness* rubber gasket — American Fastite installation is simple, rapid and permanent.

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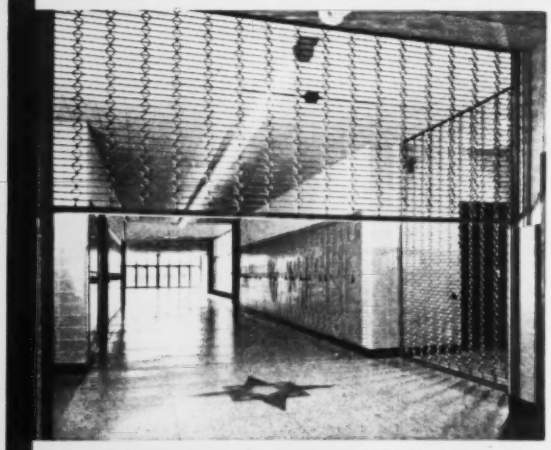

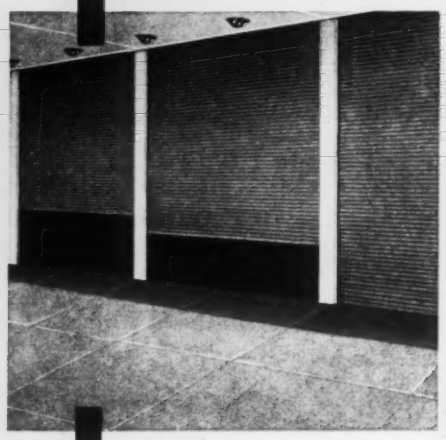

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KINNEAR ROLLING DOORS protect openings with a continuous curtain of interlocking steel slats *(a Kinnear first)* — full door efficiency plus protection against wind, weather, intrusion, and fire.

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Offices and Agents in All Principal Cities

DECEASED

(Continued from page 112)

of assistant structural engineer. For several years he was associate engineer with the Tennessee Valley Authority.

Nelson Cunliff (A.M. '17), age 70, vice-president of the William H. and Nelson Cunliff Company in St. Louis, Mo., died there recently. Mr. Cunliff began his engineering career in 1905 as an engineer with the Louisiana Purchase Exposition. For several years he was connected with the Park Department in St. Louis and had served as Commissioner of Parks and Recreation there. In 1927 Mr. Cunliff and his brother, William, formed the engineering firm, William H. and Nelson Cunliff Company.

Joseph DiStasio (M. '35), age 66, partner in the engineering firm of DiStasio and Van Buren, New York City, was killed in a train wreck at Newark Bay, N. J., on September 15. He was a graduate of Columbia University. Mr. DiStasio had been associated with the Newark Housing Authority in charge of all pre-World War II projects. During both World Wars he was active in the design of concrete ships. Three years ago Mr. DiStasio's firm was cited by ASCE, the American Concrete Institute, the Associated General Contractors of America, and the Concrete Reinforcing Steel Institute for its contribution to the advancement of reinforced concrete construction. Mr. DiStasio was recently named "Engineer of the Year" by the Brooklyn Polytechnic Institute.

Andrew Y. Freeman (M. '30), age 69, civil engineer of Westfield, N. J., died there on July 8. Mr. Freeman, who was graduated from the Case School of Applied Science, was a specialist in reinforced concrete bridges and general concrete design. He had been with the Division of Design of the Allegheny County Bureau of Bridges in Pittsburgh, Pa.; the Bureau of Engineering at Niagara Falls, N. Y.; and the Corps of Engineers as engineer of bridge design in Norfolk, Va., and in New York City. For the past several years, Mr. Freeman practiced engineering in New Jersey.

John C. Guibert (A.M. '23), age 70, retired commissioner of public works and county engineer for Nassau County, Long Island, died recently in Baldwin, N. Y. A graduate of Columbia University, Mr. Guibert began his service with Nassau County in 1922 as assistant county engineer. He was the first commissioner, taking the post in 1938 when it was first created. He was the planner of the county's $250 million sewer project, together with many other projects.

(Continued on page 118)

MONOTUBE PILE DATA

TYPE PILE—JN
TIP DIAMETER—8 inches
BUTT DIAMETER—16 inches
GAUGE—#3
LENGTH—50-110 feet
DESIGN LOADING—50 tons
UNSUPPORTED LENGTH—approx. 30 feet
DESIGN—U. S. Navy Bureau of Yards & Docks
GENERAL CONTRACTOR: Raymond Concrete Pile Co.
PILE DRIVING CONTRACTOR: Raymond Concrete Pile Co.

STABILITY WITH MONOTUBES . . . ideal as piles with long unsupported lengths in pier work. In the construction of the 1,350-foot U.S. Navy berthing pier, Newport, R. I., piles in excess of 100 feet in length were driven in perfect alignment facilitated by the extreme rigidity of Monotubes.

Tapered, fluted Monotube piles are available in lengths, diameters and gauges to meet every requirement. Write The Union Metal Manufacturing Co., Canton 5, Ohio, for complete information.

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This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient non-profit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose eight cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

Men Available

CIVIL ENGINEERING, M. ASCE, 56; registered in North Carolina, New York, Maryland, Washington, D. C., Virginia, Nebraska, Ohio and South Carolina. Engineering and law degrees; 33 years of broad consulting and federal experience. Expert contract and specification writer. Special investigations. C-388.

FIELD ENGINEER, J.M. ASCE, B.S.C.E., 27. Investigated errors at and assisted erector at power plant construction site. Set up shipping schedules. Estimated costs of entire power plants—one year and eight months. Taught electronics at U.S. Army school while in the Army—one year. Inspected natural gas pipeline construction and analyzed gas pipeline networks to improve on gas flow efficiency—seven months. Location desired, East and Midwest. C-389.

CIVIL ENGINEER, J.M. ASCE, B.C.E., 27. Twenty months with railroad plus 18 months as cooperative student. Balanced experience including both office design and field layout of industrial sites, trackage, drainage structures, and new alignment including construction surveys. California E.I.T. certificate. Presently in military service, available mid-April, 1959. Location desired, South. C-390.

ADMINISTRATIVE OR SUPERVISORY, A.M. ASCE, B.S. in C.E., 37; P.E. license in Pennsylvania and Connecticut. Twelve years' experience subdivision work including surveying, layout, computing, estimating, design of utilities. Location desired, Central Connecticut and Southern Massachusetts. C-391.

FIELD ENGINEER, J. M. ASCE. B.S.C.E., 37, E.I.T. Five years' industrial building design, reinforced concrete and structural steel. Now employed by national concern producing steel building products. Desire responsible field position with consultant or general contractor. Location desired, Michigan. C-392.

CIVIL ENGINEER, M. ASCE, 62, degree, state licenses. Thirty-five years' experience design, construction and administration; bridges, parkways, thruways, airports, harbor works, railroads, underpinning and foundations. C-395.

CIVIL ENGINEER, J. M. ASCE, B. S. in C. E., 22; one year and four months' in engineering department of major oil refinery as civil engineer. Experience in steel detailing for reinforced concrete structures. Location desired, East Coast. C-394.

PROFESSOR, A. M. ASCE, C. E., Ph.D., 50. Twenty years' experience teaching fluid mechanics, hydraulic engineering, hydrology and sanitary engineering. During past several years hydraulic design engineer with leading consulting engineering firm. Desire return to teaching. Location preferred, West Coast. S-1721-San Francisco.

Positions Available

TEACHING PERSONNEL in engineering, mathematics, physics and chemistry. Program of development includes strengthening faculty, inaugurating a graduate program and designing a new science and engineering building. Location, Middle East. F-6237.

CIVIL ENGINEERS. (*a*) Project Manager, graduate civil, with at least 20 years' supervisory hydro-electric engineering and construction experience covering high arch dam, tunnels and power plant facilities. Salary, $20,000-$25,000 a year. (*b*) Project Engineer, civil graduate, with at least ten years' experience covering administration of construction contracts for major hydro-electric projects including surveys and investigations. Salary open. Location, Middle East. F-6469.

PROFESSOR AND HEAD OF CIVIL ENGINEERING DEPARTMENT, preferably with broad teaching and engineering training, to take charge of program at technical institute. Two-year contract. Salary open. Location, Middle East. F-6470.

ASSISTANT MATERIALS ENGINEER, graduate civil or chemical, with at least five years' experience in the testing of asphalt, concrete and other construction materials. Some experience with bituminous products desirable. Salary, $6,500 a year to start. Location, Massachusetts. W-6485.

SUPERINTENDENT OF STREETS, graduate civil engineer, with practical and demonstrated effectiveness in the field of public works including the following: Care and maintenance of streets, sewers, sidewalks, motor equipment, snow removal, ash, paper and garbage collection. Position is with a community of approximately 60,000 inhabitants. Salary, to start, $10,000 a year. Location, Massachusetts. W-6499.

ENGINEERS. (*a*) Civil Engineer, graduate, with at least five years' professional experience in water, sewer and highway design. Short-term contract. Salary open. (*b*) Structural Engineer with experience as estimator and specifications writer in structural, civil and mechanical engineering. Salary, $9,996 a year, plus $150 a month living allowance; transportation provided and medical, dental, PX and commissary privileges authorized. Contract for a minimum of one year. Location, Mediterranean area. F-6501.

CONSTRUCTION ENGINEER, civil graduate, with structural steel and reinforced concrete design, specification and field engineering experience covering industrial buildings, tunnels and heavy construction. Salary open. Must be U.S. citizen. Location, Midwest. W-6503.

ENGINEERS. (*a*) Sanitary Engineer with several years' experience as an engineer and chemist in the field of water supply. Salary commensurate with experience and ability. (*b*) Water Supply Engineer, graduate civil, with some distribution system experience including supervision, design, construction and operation. Must be capable of assuming responsibility and progressing in this field with a growing organization. Salary commensurate with ability. Applicants apply by letter giving complete information as to education, previous employment, salary requirements, etc. Location, New York Metropolitan area. W-6509.

ENGINEERING OFFICE MANAGER for architects and engineers, engineering graduate, plus business experience; with ten to twenty years' experience in an architects and engineers office preparing reports of technical nature, letter writing and report preparation; know how to supervise accounting and render financial reports; visit with clients and represent company on business matters. Salary, about $12,000 a year. Headquarters, Athens, Greece. F-6516.

CIVIL ENGINEER with extensive experience in the design and construction of large capacity water supply projects including pumping stations and intake structures. Apply by letter including a complete resume and salary requirements. Employer will negotiate placement fee. Location, upstate New York. W-6520.

ESTIMATOR AND CONSTRUCTION ENGINEER, graduate civil, for a young, aggressive firm doing general construction, industrial, commercial and institutional work. Three to five years' experience required. Opportunities and benefits. Location, southeast Ohio. W-6528.

TOWN ENGINEER, registered engineer, to assume responsibility for public works problems, except water works. New position. Starting salary, $8,000 a year. Location, Connecticut. W-6534.

ASSOCIATE OR ASSISTANT PROFESSOR to teach and conduct research in hydraulics. An advanced degree required. Salary open. Location, Southeast. W-6537.

CIVIL ENGINEER, either a recent graduate or with less than five years' experience, to do both office and field work in a consulting firm. Good salary, excellent opportunity. Location, upstate New York. W-6557.

ARCHITECT, CIVIL ENGINEER OR ARCHITECTURAL ENGINEER, degree; registered engineer preferred; with two or more years' experience in the master planning of U.S. Air Force air bases including preparation of the master planning folders, field surveys and examination of utilities, road systems, communications and navigational aids; complete familiarity with USAF construction programs and methods; familiarity with maintenance and operation of self-contained installations, including utilities, plants and systems, buildings, pavements and grounds. Short-term contract; salary open. Location, Mediterranean area. F-6564.

VICE PRESIDENT, civil or structural engineer, registered, with sales or contract experience for structural steel fabricator. Should be qualified in structural design, proposals, contracts and client contact. Salary, $15,000-$25,000 a year, commensurate with qualifications and experience. Location, Pittsburgh, Pa., area. W-6568.

SENIOR HYDRAULIC ENGINEER, graduate civil, with two years' experience in hydraulics engineering, and an interest in surface water resources development, flood control, reservoir and dam design, and/or open channel hydraulics. Salary, $5,700-$6,900 a year. Must be resident of New Jersey as position is located in that state. W-6569.

SENIOR SANITARY ENGINEER, P.E. license desirable but not necessary. Must be capable of handling design of sewerage systems and treatment plants and have knowledge of water systems. Must have ability to handle men as this position will shortly lead to supervisory position. Salary, $7,800-$8,320 a year. Opportunity for overtime and fringe benefits. Company will pay placement fee. Location, Connecticut. W-6613.

(*Continued on page 117*)

ESPS

(*Continued from page 116*)

CHIEF DESIGNERS. (*a*) Chief Canal Designer, graduate engineer, to supervise group of designers on canal design and construction. Salary, $14,000-$15,000 a year. (*b*) Assistant Chief Canal Designer on above. Salary, to $14,000 a year. (*c*) Designers on canal design. Salary, to $12,000 a year. All positions minimum of 18 to 24 months contract, complete foreign and U.S. tax free, western style housing furnished free, except for utilities for a consultant. Employer will pay placement fee. Location, Japan. C-7030.

DESIGNERS, Senior and Junior, Structural degree, minimum of twelve years' for Senior, five years' for Junior, experience in design and supervise structural projects relating to buildings; foreign experience desirable. Work with group on architectural and engineering professional services. Able to train native technical and administrative talent, appreciation for underdeveloped native cultures and races; apply by letter. Dependents, additional housing allowance; one year contract, possible extension. Salaries: (*a*) $11,000; (*b*) $9,000 a year. Location, Far East. S-3836.

SPECIFICATION WRITER, construction background, minimum of 12 years' experience preparing specifications, contracts for architectural engineering work and related documents, additional experience estimating, quantity surveys and foreign experience preferable. Work with group on architectural and engineering professional services. Able to train native technical and administrative talent, appreciation for underdeveloped native cultures and races. Apply by letter. Dependents, with additional housing allowance. One year contract, possible extension. Salary, $11,000 a year. Location, Far East. S-3837.

CONSTRUCTION ENGINEERS, Senior and Junior, graduate civil, structural or mechanical, minimum of twelve years' for senior, five years' for junior. Senior must have had administration experience; overseas experience desirable. Will build industrial plants, schools, hospitals, health centers, housing. Work with group on architectural and engineering professional services. Able to train native technical and administrative talent, appreciation for underdeveloped native cultures and races. Apply by letter. Dependents, additional housing allowance. One year contract, possible extension. Salaries: (*a*) $11,000; (*b*) $9,000 a year. Location, Far East. S-3838.

SITE PLANNERS, Senior and Junior, civil engineer, minimum of twelve years' experience for senior, junior five years' experience in site planning for residential and industrial areas. Work with group on architectural and engineering professional services. Able to train native technical and administrative talent. Appreciation for underdeveloped native cultures and races. Apply by letter. Dependents and additional housing allowance. One year contract, possible extension. Salaries: (*a*) $11,000 a year; (*b*) $9,000 a year. Location, Far East. S-3841.

SENIOR ARCHITECT, architectural degree, minimum of eight years' experience, some as Senior, preferably with overseas experience on industrial plants, schools, hospitals, health centers, housing. Will work with group on architectural and engineering professional services. Able to train native technical and administrative talent, appreciation for undeveloped native cultures and races. Dependents, additional housing allowance. One year contract, possible extension. Apply by letter. Location, Far East. S-3846.

RECENT BOOKS

Buildings For Research

Discusses the requirements of good laboratory design and provides information on such factors as safety measures, waste removal, corrosion prevention, vents and chains, and modular units. This is followed by descriptions of research buildings in the fields of nucleonics, biology, electronics, and chemistry. A special section deals with atomic processes and equipment as they affect the design of the laboratory. This is a collection of articles published in Architectural Record since 1950. (Published 1958 by F. W. Dodge Corporation, 119 West 40th St., New York 18, N. Y. 224 pp., bound. $9.50.)

Digital Techniques For Computation And Control

A survey of the basic techniques used for digital computation and control, including code arithmetic, logical networks, multiplexing, conversion, data reduction, digital process control, two-terminal relay circuits, counting techniques, digital computers of all types, computer programming, digital differential analyzers, and combined analog-digital equipments. Descriptions of components and available commercial equipments add to the value of the book, by Martin L. Klein and others. (1958, Instruments Publishing Company, Inc., 845 Ridge Avenue, Pittsburgh 12, Pa. 394 pp., bound. $6.00.)

Dock And Harbor Engineering

Volume 1: The Design of Docks

The first volume of this set by Henry F. Cornick, deals specifically with the design of docks. Beginning with the general principles of design and with descriptions of typical dock layouts, it continues with dock and wharf walls; entrances and locks; graving docks, boating docks, and slipways; lock gates and caissons. This work is a revision of two earlier works by Brysson Cunningham entitled "Dock Engineering" and "Harbour Engineering". It is fully illustrated, references are listed after each chapter, and there is a detailed index. (1958, Charles Griffin & Company, Ltd., London, England. 316 pp., bound, £5.5s.)

Fluid Dynamics And Heat Transfer

James G. Knudsen and Donald L. Katz bring together both theoretical aspects and quantitative data on heat transfer and fluid dynamics. The authors discuss the basic differential equations of fluid flow and their application to ideal flow, laminar and turbulent flow past immersed bodies, and flow in heat exchangers. The basic energy equation for fluid flow is derived and applied, along with the momentum equations, to forced convection heat transfer in closed conduits and from immersed bodies. (1958, McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y. 576 pp., bound $12.50.)

Trouble-Free Hydraulics

Ian McNeil covers the following areas: an introduction to the hydraulic system and the problems of maintenance; pipework and oil tanks; hydraulic seals and packings; the diagnosis and cure of faults. (1958, Ronald Press Company, 15 East 26th Street, New York 10, N. Y. 124 pp., bound. $6.50.)

Wasserstrahlpumpen Zur Forderung Von Flussigkeiten

A presentation of the results of extensive tests on water-jet pumps for the conveying of fluids. Experiments were carried out with both air and water, and the results are graphically shown. The effects of various shapes and conditions are discussed, and a brief presentation of the theory involved is included by authors Ferdinand Schulz and Karl Heinz Fasol. (1958, Springer-Verlag, Vienna, Austria. 73 pp., paper. $3.55.)

Water Power Engineering

Rolt Hammond begins with a survey of the water power industry and such aspects as planning, underground power stations, geological factors, and the relationship between water and nuclear power. The main types of turbines are then studied with stress on full scale and model tests and on cavitation. Such electrical problems as insulation, high voltage transmission, voltage regulation, and cables are also considered. (1958, Heywood & Co., Ltd., London, England; distributed by Macmillan Company, 60 Fifth Avenue, New York 11, N. Y. 302 pp., bound. $10.00.)

Water-Resource Development: The Economics Of Project Evaluation

Analyzes the methods used to justify federal water resource programs. The theoretical basis for benefit cost calculations is examined as well as the practical application of these criteria to such areas as flood control, navigation, irrigation, and electric power. The author, Otto Eckstein, attempts to identify the major sources of bias and makes suggestions to improve the evaluation practices. (1958, Harvard University Press, Cambridge 38, Mass. 300 pp., bound. $6.50.)

Winter Concreting: Proceedings Of The Rilem Symposium, 1956

Papers on a wide range of problems of winter building, given at a symposium sponsored by the Danish section of the International Union of Testing and Research Laboratories for Materials and Structures. The papers, mostly in English, cover the following broad areas of study: climatic conditions and their reproduction in the laboratory; resistance of concrete to early freezing; hardening as influenced by temperature; resistance to frost; securing adequate quality of concrete; winter concreting on the job site.

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DECEASED

(Continued from page 114)

Ivan M. Glace (A.M. '20), age 71, retired president of Glace and Glace, Inc., Harrisburg, Pa., consultants, died there on September 6. Mr. Glace, who studied at Johns Hopkins University, was a specialist in water works. In recognition of his services to the Pennsylvania Water Works Operators Association, the association established an annual award in his name to be given to the outstanding member of the association. Until his retirement in 1957, Mr. Glace was president of Glace and Glace, Inc., the firm he founded in 1935.

I. M. Glace

Harry H. Hemmings (M. '24), age 62, adjunct professor at the Brooklyn Polytechnic Institute, died recently in New York City. A civil engineering graduate of Cornell University, Professor Hemmings had done a great deal of work in highway and city planning. He had served as assistant engineer with the Regional Plan of New York and as resident engineer for the Louisville Traffic Survey. For several years he was with the Metropolitan Life Insurance Company as engineer on public safety and traffic and later as assistant to the vice-president. Professor Hemmings had been with the Brooklyn Polytechnic Institute since 1948.

William B. Hill (M. '52), age 58, assistant construction engineer with the Florida and East Coast Railway Company, died in St. Augustine, Fla., on September 16. A civil engineering graduate of the University of Maryland, Mr. Hill had served as an Indian agent in Oklahoma, Nevada, and Florida. He was instrumental in the construction of a reservation for the Apache Nation in Oklahoma. Mr. Hill had been with the railroad for many years. He was a War War II veteran.

Thomas H. Hogg (M. '19), age 74, retired engineer of York Mills, Ontario, died there recently. A graduate of the University of Toronto, Mr. Hogg was engaged for many years in the construction of hydraulic and hydroelectric projects. A former editor of "Canadian Engineer," he was assistant hydraulic engineer, chief engineer, and chairman of the Hydro-electric Power Commission of Ontario. He had also served as a consultant to the Canadian government in connection with many large projects, including study and development of the St. Lawrence Waterway.

Charles O. Holman, Jr. (J.M. '49), age 34, project engineer for the Stimson Corporation of Dallas, Tex., died there on August 19. Mr. Holman was graduated from the Texas Technological College in 1949, and joined the Stimson Corporation immediately thereafter. Mr. Holman was a veteran of the Air Force in World War II.

Ronald T. Hyland (M. '42), age 71, owner of the Hyland Construction Company of Long Beach, Calif., died there on August 13. Mr. Hyland received his civil engineering degree from the University of Toronto and spent most of his career in construction work—for some years as head of his own construction company in Canada. He later expanded his company to Long Beach, Calif., and Evanston, Ill. For several years Mr. Hyland was general superintendent and estimating engineer of the L. E. Myers Company in Chicago.

Stanley G. Kadala, Jr. (A.M. '53), age 36, design director for the District Public Works Office, Tenth and Fifteenth Naval Districts, San Juan, P. R., died in Coral Gables, Fla., on September 6. A native of Chicago, Mr. Kadala spent most of his life in Puerto Rico. He received his B.S. degree from the University of Puerto Rico and his M.S. degree from Johns Hopkins University, and had taught civil engineering at the University of Puerto Rico. He was construction and maintenance engineer for the U.S. Armed Forces Antilles in Puerto Rico. Since 1953 he had been serving with the Tenth Naval District in San Juan, and in 1957 was promoted to director of the Design Department of the consolidated Tenth and Fifteenth Naval Districts.

Ralph W. Kennedy (M. '24), age 69, retired railroad engineer, died in Seattle, Wash., on July 7. Mr. Kennedy was graduated from the State College of Washington. He retired six years ago after 30 years in the engineering departments of the Santa Fe Railroad of Chicago, Ill., and the Wabash Railroad of St. Louis, Mo. While with the Santa Fe, he was engaged in railroad location, and with the Wabash he served as roadway engineer in charge of valuation and later he worked with relocation and construction. He was a veteran of both wars, serving in World War II as principal engineer in charge of the construction of ordnance and air bases in Minnesota, Kansas, Arkansas, and Missouri.

Arthur D. Kidder (M. '25), age 82, consulting engineer and partner in Kidder and Thoma, cadastral engineers of Terre Haute, Ind., died there on June 13. A graduate of Rose Polytechnic Institute in Terre Haute, Mr. Kidder was the holder of an honorary doctorate of engineering from his alma mater. Since 1947 he had been senior partner in Kidder and Thoma. The Department of the Interior cited Mr. Kidder in 1948 for his "valuable scientific contributions which have been adopted and put in use throughout much of government service."

(Continued on page 119)

DECEASED

(*Continued from page 118*)

Howard King (M. '36), age 68, vice-president and chief engineer of the Mason and Hangar Company, Inc., in New York City, died in Port Washington, N. Y., on September 21. An engineering graduate of the Massachusetts Institute of Technology, Mr. King began his career with the New York Public Service Commission on the Montague Street Tunnel. He had been with the Mason firm since 1928 and became chief engineer in 1935. He directed construction of the north and south tubes of the Lincoln Tunnel and served as consultant on construction of the third tube. He was also associated with the building of the Holland and Brooklyn Battery Tunnels. In 1957 the Metropolitan Section of ASCE named Mr. King "Metropolitan Civil Engineer of the Year." The year before he was honored by the Moles for distinguished service.

Robert F. Krafft (A.M. '25), age 70, consulting engineer of Albany, Calif., died there on February 2. Mr. Krafft, who studied civil engineering at the University of California, did much of his work in the fields of hydraulics and irrigation. He was resident engineer on the Big Meadows Dam construction and did irrigation and municipal work in Seattle, Wash. He had worked on hydroelectric developments in British Malaya and Mexico. For many years he was assistant engineer with the Pacific Gas and Electric Company in San Francisco.

George J. Meise (A.M. '44), age 70, civil engineer in New York City, died there on March 18. He was graduated with a civil engineering degree from Manhattan College. For several years he was with H. H. Meise and Son, Inc., as designer, supervisor, and officer on building construction. For over ten years Mr. Meise served as liaison officer and civil engineer with Thomas E. Murray, Inc., New York City architects. He spent most of his career in the New York metropolitan area.

Lewis T. Ross (M. '46), age 62, retired Brigadier General in the Corps of Engineers, died recently in Webster Groves, Mo. A graduate of the U.S. Military Academy, General Ross served as acting district engineer in Honolulu for several years. He was chief of the Railway Section, Troops Division, in the Office of the Chief of Engineers. During World War II he was on Gen. Douglas MacArthur's staff at the headquarters of the U.S. Army Forces in the Far East and later became chief engineer in that theater of operation. After his retirement from the Corps in 1946, General Ross was project engineer for the St. Louis engineering firm of Sverdrup and Parcel.

William J. Shackelford (M. '12), age 87, retired engineer of Rosedale, Miss., died there recently. Mr. Shackelford was a specialist in surveying and river improvement. The major part of his work was on the Mississippi River and the surrounding areas. He had served as chief engineer with the Mississippi Levee Board and vice-president and manager of the New Hope Gravel Company. He had been in private practice for many years.

Stephen C. Whipple (A.M. '20), age 69, senior hydraulic engineer and Director of Public Works in Sacramento, Calif., died there recently. A graduate of the University of California, Mr. Whipple was a veteran of many years service with the Corps of Engineers. He had served as assistant to the District Engineer of the Philadelphia Engineer District and taught military engineering at West Virginia University. During World War II he was training supervisor of the Engineer Replacement Center at Ft. Belvoir, Va. Mr. Whipple had held his post with the Department of Public Works since 1950.

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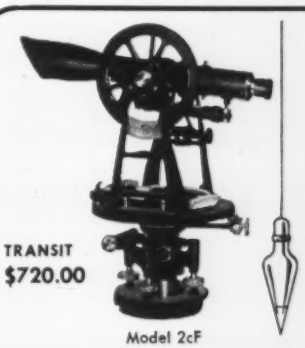

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Non-ASCE Meetings

American Association for the Advancement of Science. 125th annual meeting on National and International Aspects of Systems of Units in Coordinated Disciplines of Science and Technology, at the Statler Hotel, Washington, D.C., December 26-31. Information available from Secretary, Section M (Engineering), AAAS, c/o Engineers Joint Council, 29 W. 39th St., New York 18, N.Y.

American Institute of Chemical Engineers. 51st annual meeting at the Netherland Plaza Hotel in Cincinnati, Ohio, December 7-10. Further information available from Raymond C. Mayer & Associates, 36 W. 46th St., New York 36, N.Y.

American Nuclear Society. Annual meeting at the Sheraton-Cadillac Hotel, Detroit, December 8-10. For details write A. S. Griswold, ANS, 2000 2nd Ave., Detroit 26, Mich.

American Society of Mechanical Engineers. 23rd National Exposition of Power and Mechanical Engineering including a Symposium on Stall, New York Coliseum, New York City, December 1-5. For information write E. K. Stevens, 480 Lexington Ave., New York 17, N. Y.

American Standards Association. National Conference on Standards at the Hotel Roosevelt in New York City, November 18-20. For further information write to the Association, 70 E. 45th St., New York 17, N. Y.

Building Research Institute. Conference on Field Applied Paints and Protective Coatings at the Shoreham Hotel, Washington, D. C., December 3-4. Information available from the Division of Engineering and Industrial Research, National Academy of Sciences, National Research Council, 2101 Constitution Ave., Washington 25, D. C. Conference on Noise Control in Buildings at the New Yorker Hotel, New York City, January 14-15. For information write Harold Horowitz, BRI Technical Secretary, 2101 Constitution Ave., Washington 25, D. C.

Chamber of Commerce of the United States. National Conference on Metropolitan Growth at the Sheraton-Park Hotel in Washington, D.C., November 24-25. Information available from William McDonnell, president, National Chamber of Commerce, 1615 H St., N.W., Washington 6, D.C.

Department of Health, Education and Welfare. National Conference on Air Pollution at the Sheraton-Park Hotel, Washington, D.C., November 18-20. For information write J. E. Burney, Surgeon General, Public Health Service, Washington 25, D.C.

Eastern Joint Computer Conference. Sponsored by the American Institute of Electrical Engineers, the Institute of Radio Engineers and the Association for Computing Machinery, in Philadelphia, Pa., December 3-5. For hotel and other information contact Raymond C. Mayer & Associates, 36 W. 46th St., New York 36, N.Y.

Fourth National Construction Industry Conference. Creative Trends in Urban Building, sponsored by the American Society of Civil Engineers, the Armour Research Foundation of Illinois Institute of Technology, The Associated General Contractors of America, and the Building Research Institute, at the Hotel Sherman in Chicago, Ill., December 10-11. For information write Conference chairman R. T. Mijanovich, Armour Research Foundation, 10 W. 35th St., Chicago 6, D. C.

Positions Announced

International Cooperation Administration. Vacancies for Highway Engineers for overseas employment. Salary range—$9,000-13,000 plus housing. Applicants must have degree in civil engineering or professional engineer's license and ten or more years highway experience, preferably with a state highway department. Two year minimum assignment with career potential. For more information, send resume of experience to Office of Transportation, Transport Projects Division, Box 101, International Cooperation Administration, Washington 25, D. C. Also vacancies for Sanitary Engineers for overseas employment. Salary range—$8,000-13,000, plus housing and other allowances where applicable. Applicants must have a degree in either sanitary engineering or public health for subordinate positions, with appropriate experience for positions of more responsibility. Minimum assignment is two years. For information write Public Health Division, Box 100, ICA, Washington 25, D. C.

Pennsylvania State University. Vacancies for Assistant Professors, Instructors, and part-time Graduate Assistants in Engineering Mechanics, for both teaching and research. Excellent opportunities for graduate study. For information write Joseph Marin, head of the Department of Engineering Mechanics, College of Engineering and Architecture, Engineering A Building, Pennsylvania State University, University Park, Pa.

U.S. Civil Service Commission. Vacancies for Geodosists with varying fields of responsibility Grades from GS-5-15 with salaries dependent on grade and experience. Applicants must be U.S. citizens. Send Application Form 57, showing the title of the examination, number of this announcement (168 B), or write to Executive Secretary, Board of U.S. Civil Service Examiners, Coast and Geodetic Survey, Washington 25, D. C.

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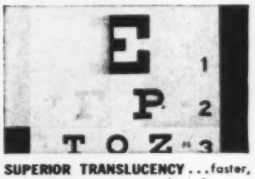

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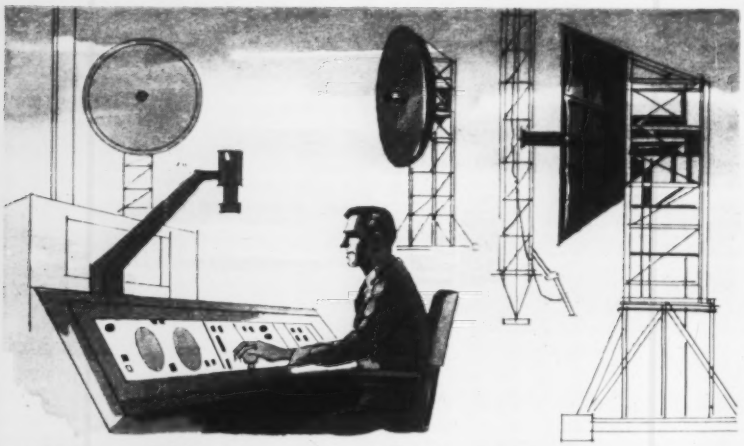
(Applications for Junior Membership from ASCE Student Chapters are not listed.)



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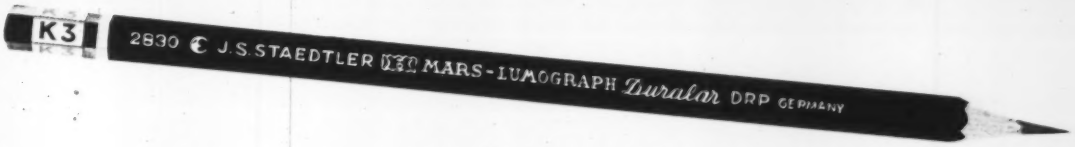

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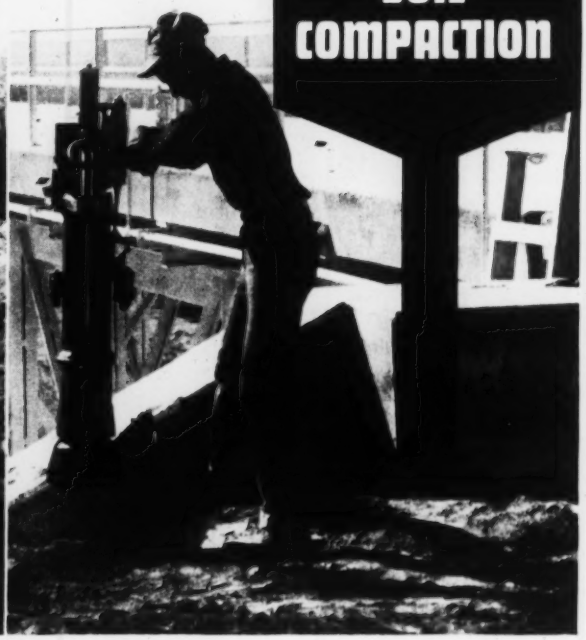
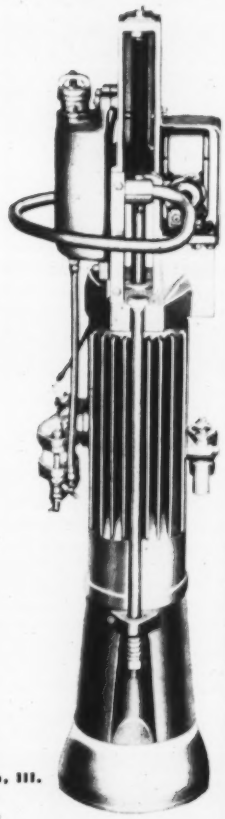


BARCO RAMMERS are THE ANSWER!



YOU can't get *high degree* SOIL COMPACTION by "patting it" or "shaking it." For deep, penetrating force to produce 95%, 97.5%, or even 100% compaction, Barco Rammers are THE ANSWER. For many soil conditions, they are the only answer.

THE KEY TO BETTER CONSTRUCTION—High degree soil compaction is worth every cent it costs. Barco Rammers are especially effective for compacting fill in restricted areas — close to walls, culverts, abutments, around footings, and in trenches—on all kinds of construction jobs: Toll Roads, Freeways, and Highways; Air and Missile Bases, Hydro-electric Power and Flood Control Dams, Bridges, Buildings, and Housing Developments.

ONE MAN OPERATION—On area tamping, one man can average 20 to 30 cubic yards of fill per hour. On 18″ trench backfill, using lifts up to 24″, the rate is 360 to 600 feet per hour.

ASK FOR A DEMONSTRATION—We will be glad to arrange a demonstration for you; see our nearest distributor or write. SEND FOR A COPY OF CATALOG 621.

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for Granular Fill and Bituminous Surfacing

The Surveyor's Notebook

Reporting on Unusual Surveying Problems and Their Solutions

Notekeeper: W. & L. E. Gurley, America's Oldest Engineering Instrument Maker

How to prove a point ...about a point...with an Optical Plummet Transit

William Dryburgh sights through his new Gurley Optical Plummet Transit.

One windy day, William A. Dryburgh, engineer in charge at the job site of a Detroit construction project, had established a point using a conventional plumb bob. A check on his set-up was important to its later use for tying in. A new Gurley Optical Plummet Transit, just demonstrated to him and to Robert Bryant, of Bryant and Detwiler Construction Company, was on hand.

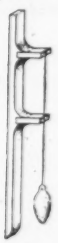
Setting up the new instrument over his point, he leveled up. Sighting in the Optical Plummet, he used the built-in shifting head tripod to bring the instrument directly over the point.

Satisfied that the instrument had remained level during shifting, he then took a sight on a target through his main telescope. Next he flipped his telescope without moving its upper or lower motion, taking a back sight on a target placed on the building behind him. His back sight did not check.

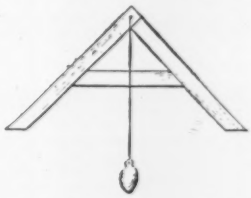
Double centering proved the instrument's perfect adjustment. Checking its levelness, he again tried fore and back sight with the same result. An obvious error existed; so he proceeded to "buck in" the Optical Plummet Transit from the targets, and found he had an error as established by his plumb bob. *Result: He kept the Optical Plummet Transit.*

The plumb bob has served men well for thousands of years. Changed very little since the Egyptian pyramid builders used it, its swing and sway can be exasperating—especially on windy locations. It is essentially inaccurate.

Gurley Optical Plummet Transits replace the outdated cord and bob with a method deriving precision from accuracy intrinsic in the laws of optics. Readings are instantaneous. Wind cannot blow it out of vertical—there is nothing to swing or gyrate. The built-in shifting head allows a 2-inch shift of instrument over point, giving ample leeway in initial set-up. Rotating the instrument 180 degrees assures you of positive centering. *Write for new Bulletin OP-100.*



Plummet level and leveling A-frame as used by the ancient Egyptians.



Ask to See the Variable Power Eyepiece

Variable Power is now *standard* on Gurley Optical Plummet Transits—and all other Gurley Transits and Levels. With "VP" you go from high to low and back again—with stops anywhere in between.

"VP" offers a clear, flat field, devoid of aberrations at any magnification. You have all the power required for the longest sight, and reduced power for local conditions. You will find visibility under poor lighting can be improved by use of lower magnification. Turbulent effect of heat waves is minimized with lower power. Write for "Facts on VP".

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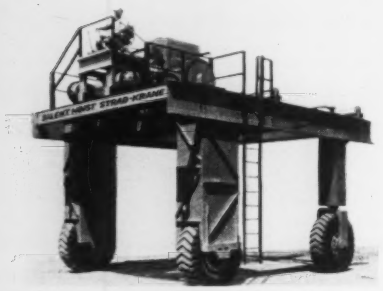
EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Strad-Krane

ONE OF THE NEWEST concepts in materials handling, the Strad-Krane is a traveling bridge plus a mobile crane in one. The prime feature is that it is not of the usual cantilever type, the center of the load is always inside of the wheel supports, eliminating the need for counterweights, stabilizers or jacks, allowing a new unrestricted freedom in mobility and



Goes Where Needed

function. The load to be carried is suspended from a hook under the frame of the unit. Controlled by a trolley bridge hoist located on the top structure, the hook can travel from one end of the machine to the other transversely and also up and down, duplicating the action of a shop overhead crane. The Strad-Krane is not confined to rail tracks as it is self-propelled on pneumatic tires and goes wherever needed.

The machine's power steering and power brake features keep the operator fatigue-free while simultaneously speeding up the completion of each task. To make his job even easier, the 450-cu in. 6-cylinder power plant is equipped with a directional power shift automatic transmission. Also, the hoisting element for the main hook lines and for the power trolley is through a smooth hydraulic transmission.

The new machine does all the chores of a fork lift truck and a mobile crane in unloading steel, cable and other material from motor trucks and loading and unloading railroad freight cars. Inside clearances are 12-ft high and 12-ft wide, large enough for the Strad-Krane to straddle a truck or freight car. **Silent Hoist & Crane Co., Dept. 143, CE-11, 841 63rd Street, Brooklyn 20, New York.**

Wire Rope

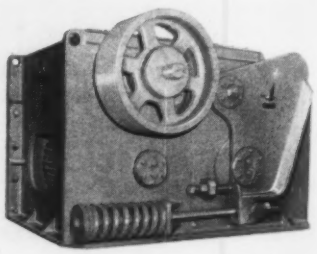
THE STRENGTH AND DURABILITY of elevator ropes, together with the automatic controlling devices on the elevator, combine to make this mode of travel the safest form of mass transportation in the world today, according to the company whose wire rope suspends the elevators in some of the tallest buildings in the world. It recommends that a rope always be much stronger than the load which it is expected to support. The degree of excess strength over working load—the safety factor—varies with a number of conditions of use, including speed of operation, abrasion and corrosion, facilities for inspection of the rope, and the danger to life and property should a rope fail.

With all these factors in mind, the manufacturer suggests rope for high-speed elevators with a minimum safety factor of 12 to 1. This is to say if an elevator with a carrying capacity of 15 passengers were to be jammed with 150 people—or ten times the recommended number—these ropes would hold.

Other features making modern elevators the safest of all power-driven transports are the governors which automatically control a series of devices to slow down the car or cut the power if the car begins to accelerate out of control; terminal switches independent of other controlling mechanisms to stop the car at the upper and lower limits of travel; and electric circuits completed by contact points in the doors on the various floors which permit operation only when the doors are closed. **American Steel & Wire Div., United States Steel Corp., CE-11, Rockefeller Bldg., 614 Superior Ave., N.W., Cleveland 13, Ohio.**

Roll Crushers

TWO NEW ROLL CRUSHERS in sizes 24 x 20 and 30 x 24 have been developed. Rolls are of manganese steel and are furnished either both smooth or both corrugated or one of each. These pressure rolls are turned by steel cut gears running in oil for greatest efficiency and longer life as well as quieter operation. Heavy-duty, self-aligning, spherical roller



Heavy Plate Steel Frame

bearings carry the tremendous loads in these crushers. All welded, heavy plate steel frame houses this newly designed unit.

Through tension springs one roll is fixed and the other floats, supplying ample crushing pressure yet relieving undue strain resulting from tramp iron and other foreign materials. Adjustment of the opening between the rolls (up to 3 in.) is accomplished by adjusting screws on either side.

According to the manufacturer's specifications horsepower required for the smaller unit is 75 to 125 while the larger one needs 100 to 200. Respective weights are 12,000 lb and 16,000 lb. **Eagle Crusher Company, CE-11, 1000 Harding Way, East, Galion, Ohio.**

Commercial Wheel Tractors

IN ANSWER TO THE varied power requirements of industrial and commercial work, a new line of wheel tractors in six-power sizes has been introduced.

Smallest is the handy Cub Lo-Boy, es-

460 Utility Tractor

pecially adapted to light utility work such as mowing, landscaping, and grading. Next in line is the light-duty 140, with an estimated 28 ehp, available with either gasoline or distillate engine. The 240, estimated 38 ehp, and the 340 Utility, estimated 45 ehp, are available with choice of gasoline, LP Gas, or distillate engines. The 460 Utility, with an estimated 61 ehp, and the 560, estimated 72 ehp, workhorse of the industrial line, are equipped with multi-range, six-cylinder gasoline, LP Gas, distillate or diesel engines.

These new multi-range, six-cylinder engines are built to handle efficiently a wide range of jobs, big and small, with the engine governor operating effectively over the unusual range of 600 to 1800 rpm. Smoothness in operation and freedom from vibration results principally from a precision counter-balanced crankshaft; machined combustion chambers that provide accurately controlled volume in each cylinder; and inherent characteristics of six cylinders. **International Harvester Company, CE-11, 180 North Michigan Avenue, Chicago 1, Ill.**

When you order ready-mix concrete, specify—

SPECIAL WINTERIZED

Including SOLVAY Calcium Chloride

—and save these 5 ways...

1. **Quicker setting**—less overtime finishing.
2. **High early strength**—faster form removal.
3. **Savings in protection time**—as much as 50%.
4. **Less delay** between operations.
5. **Added safety**—extra cold weather protection.

With a "Special Winterized" mix containing 2% of SOLVAY Calcium Chloride, heated water and aggregate, you keep close to warm weather schedules at any temperature—get concrete with 8 to 12% greater ultimate strength . . . more workability. This permits lower water-cement ratio, resulting in denser and more moisture- and wear-resistant concrete.

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SOLVAY Calcium Chloride speeds but does not change the normal chemical action of portland cement. Impartial tests by the National Bureau of Standards proved its advantages in cold weather concreting. This use of calcium chloride is recommended or approved by leading authorities, including American Concrete Institute and Portland Cement Association.

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SOLVAY dealers and branch offices are located in major centers from coast to coast.

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Over 36 Outstanding Features Found on No Other Concrete Saw!

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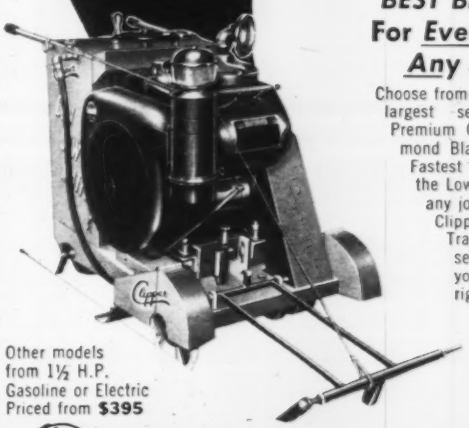

Other models from 1½ H.P. Gasoline or Electric Priced from **$395**

BEST BLADES For Every Saw Any Job!

Choose from the world's largest selection of Premium Quality Diamond Blades for the Fastest Cutting at the Lowest Cost on any job. Let your Clipper Factory Trained Representative help you select the right Saw and Blades for your job! **Call him Collect Now!**

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EQUIPMENT, MATERIALS and METHODS

(continued)

Rock Backhoe Bucket

A NEW ROCK BUCKET, the "25", featuring heavy-duty construction throughout, has been developed. Weighing 725 lb, it is ideal for digging in extra tough ground conditions and rock. The bucket is adaptable to the goose-neck backhoe design on either the carrier-mounted, crawler-mounted, or self-propelled cranes-excavators. **Schield Bantam Co., CE-11, Waverly, Iowa.**

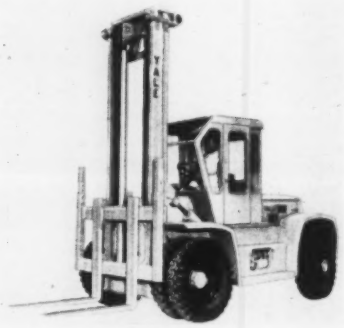
G-3 Cab

AN OPERATOR'S CAB WITH ample room for comfort and offering full visibility has been introduced as optional equipment on the company's line of G-3, 15,000 to 20,000-lb capacity line of gasoline powered lift trucks.

Without interfering with the placement of an overhead canopy guard, the cab provides 43½ in. from the seat to the roof to give the operator plenty of headroom.

More than 40 sq ft of heat resistant, safety glass in panels surround the operator in the cab giving him visibility to the front, rear and all sides as well as up at his load in the raised position. This is in keeping with the overall design of the truck whose channels provide 300% greater visibility than comparable models.

The cab can be entered from either side through sliding doors, eliminating the danger of damage inherent in swinging type doors. For hot weather operation, the G-3 cab can be ventilated through the rear window which is hinged to be swung out. A windshield wiper is standard equipment and a heater and defroster can be easily installed as optional. With the exception of the window panels, the whole cab is of steel construction mounted in rubber. **The Yale & Towne Manufacturing Co., CE-11, 11,000 Roosevelt Blvd., Philadelphia 15, Pa.**



Full Visibility

New Bucket

THE SLACKLINER BUCKET APPLIES certain characteristics of the Crescent Drag-Scraper to a new line of Cableway buckets. The design permits the bucket to be made lighter in weight for a given strength and it requires less line pull than other buckets of the same rated capacity.

The Slackliner has a continuously curved cutting edge designed to quickly penetrate hard digging material and move it into the bucket with minimum resistance. This curve also gives more tension in the cutting edge and much less bending stress.

The bucket is a complete welded assembly, including maintenance items. There are rolled high-strength steel plates throughout and integral tooth bases. Now successfully operating in the field, it is handling more material with less maintenance and with a reduction in power costs. **Sauerman Bros., Inc., Dept. C-15, CE-11, 620 S. 28th Ave., Bellwood, Ill.**

ACCURATE GRAPHIC AND VISUAL REGISTRATION

of liquid flow with

STEVENS

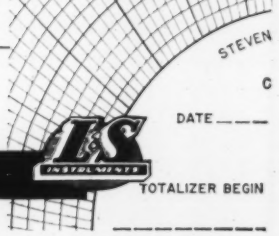
RECORDER TYPE B-FT

Recording, indicating and totalizing meter for measuring sewage or other flows over Parshall flumes and weirs. This instrument has interchangeable flow cams and flow conversion gears... an important factor to consider for sewage treatment plants in rapidly growing communities. With a simple change of cams and gears the Type B-FT Recorder can operate with a different size flume or accommodate a greater range of flow than that for which it was originally purchased. The change does not require factory service. Similarly, change from weekly to daily time scale, or vice versa, is accomplished by merely repositioning one gear — no new parts to buy.

This recorder can be direct float operated or remotely controlled and is available for wall or switchboard mounting, or with cabinet for mounting out of doors directly over the float well. Request BULLETIN 25 for complete details.

STEVENS HYDROGRAPHIC DATA BOOK

Invaluable for your reference file. Contains technical data on recorder installations, plus a wealth of hydraulic and conversion tables. $1 copy. (No COD's)



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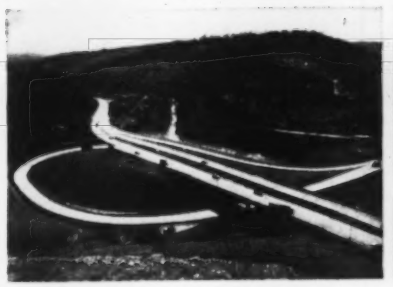

properly jointed to provide a greater and more economical service lifetime

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This manual, entitled "Design Practices and Uses of Premoulded Joints in Concrete Pavements," features comprehensive technical data and illustrations of premoulded joint types, their applications and installation information. Send coupon today for your free copy.

The above highways, all properly jointed, were designed by forward thinking engineers for progressive state highway departments. Men who know that it pays to look beyond the initial cost, and design their highways to provide a greater and more economical service lifetime. Modern, properly jointed highways will help to reduce massive yearly maintenance costs. It will be to the advantage of every design engineer and state highway department to remember that dollars saved through reduced maintenance will provide miles of new highways for the same public expenditure.

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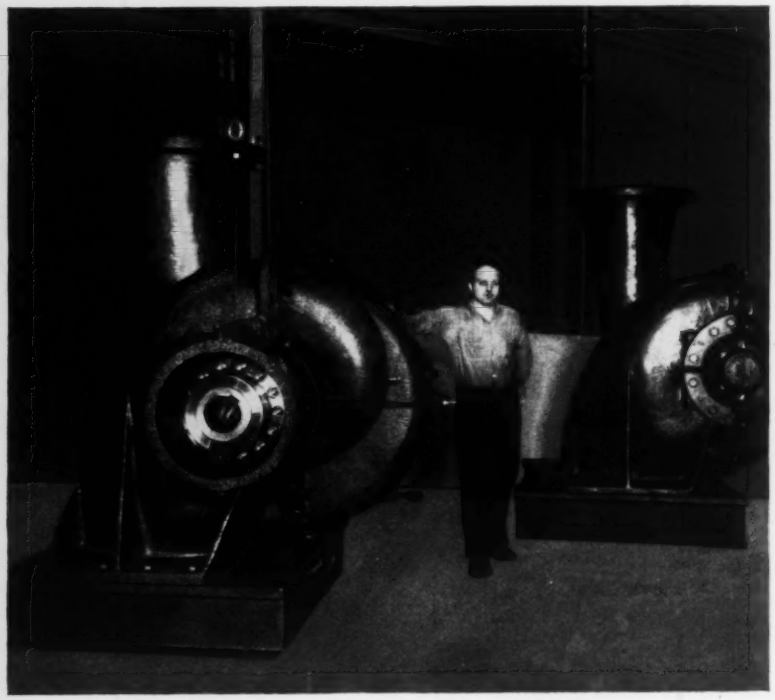
EQUIPMENT, MATERIALS and METHODS

(continued)

Portable Drilling Machine

THE NEW MOBILE, HIGH speed, heavy-duty machine that drills clean, perfect holes 10 to 15 times faster through reinforced concrete, marble, granite, cement, brick, tile, stone and other hard, brittle, non-metallic materials is equipped with a 2¼-hp electric drill motor and an integral water swivel which supplies water to the cutting face of a diamond drill to cool the bit and flush away cuttings. The water fitting may be connected to any supply line and, if running water is not readily available at the job location, the unit may be hooked up to a portable pressure water tank. Simple to operate, from a vertical or horizontal position, the machine can be swung through 360 deg to drill in any position and at any angle. The wheel-mounted stand makes the unit flexible and fast to handle. **Diamond Core & Saw Div., Portomag, Inc., CE-11, 1521 East Nine Mile, Detroit 20, Mich.**



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At the Owyhee Irrigation Project, Homedale, Idaho, the problem was four high-capacity pumps which would move water from the Snake River to an irrigation canal 180 feet above. C.H. Wheeler solved it with the 30" x 24" Double-Suction Pumps shown here, each rated at 19,000 gpm, and two 36" x 24" Double-Suction Pumps rated at 19,700 gpm.

With nearly three-quarters of a century of pump design and manufacturing experience, C.H. Wheeler is well qualified to solve pump problems of any size and any degree of complexity. Applications include flood control, irrigation, drainage, water supply and condenser circulation. Capacities of Wheeler-Economy Pumps range from 50 to more than 220,000 gpm.

See your Wheeler-Economy representative or write direct for information on centrifugal, axial or mixed flow pumps custom made for any high-capacity need.

Economy Pump Division

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Whenever you see the name C. H. Wheeler on a product, you know it's a quality product

Centrifugal, Axial and Mixed Flow Pumps • Steam Condensers • Steam Jet Vacuum Equipment • Marine Auxiliary Machinery • Nuclear Products

Microfilm Camera

THROUGH ENGINEERING RE-DESIGN TO incorporate a built-in volt meter, repeated color "step tests" have been eliminated in the new Transportable Film-a-record Model 8.1 precision-built microfilm camera.

All guess-work is removed when working with different colored documents. A color "step-test" strip of film will be supplied with each camera noting the proper settings for colored documents.

Since many of the documents to be microfilmed will be of different colors and each color has the ability of reflecting a different intensity of light, the film used with the model 8.1 camera has been engineered to a very stable acceptance to uniform light. To compensate for the variations in light reflected from different colored records, the volt meter is adjusted to the proper setting. **Remington Rand Division of Sperry Rand Corp., CE-11, 315 Fourth Ave., New York 10, N. Y.**

New Rotary Drill

A NEW HEAVY DUTY combination air blast and mud fluid rotary drill is reputed to be suitable for gas, oil and water well drilling, as well as all types of

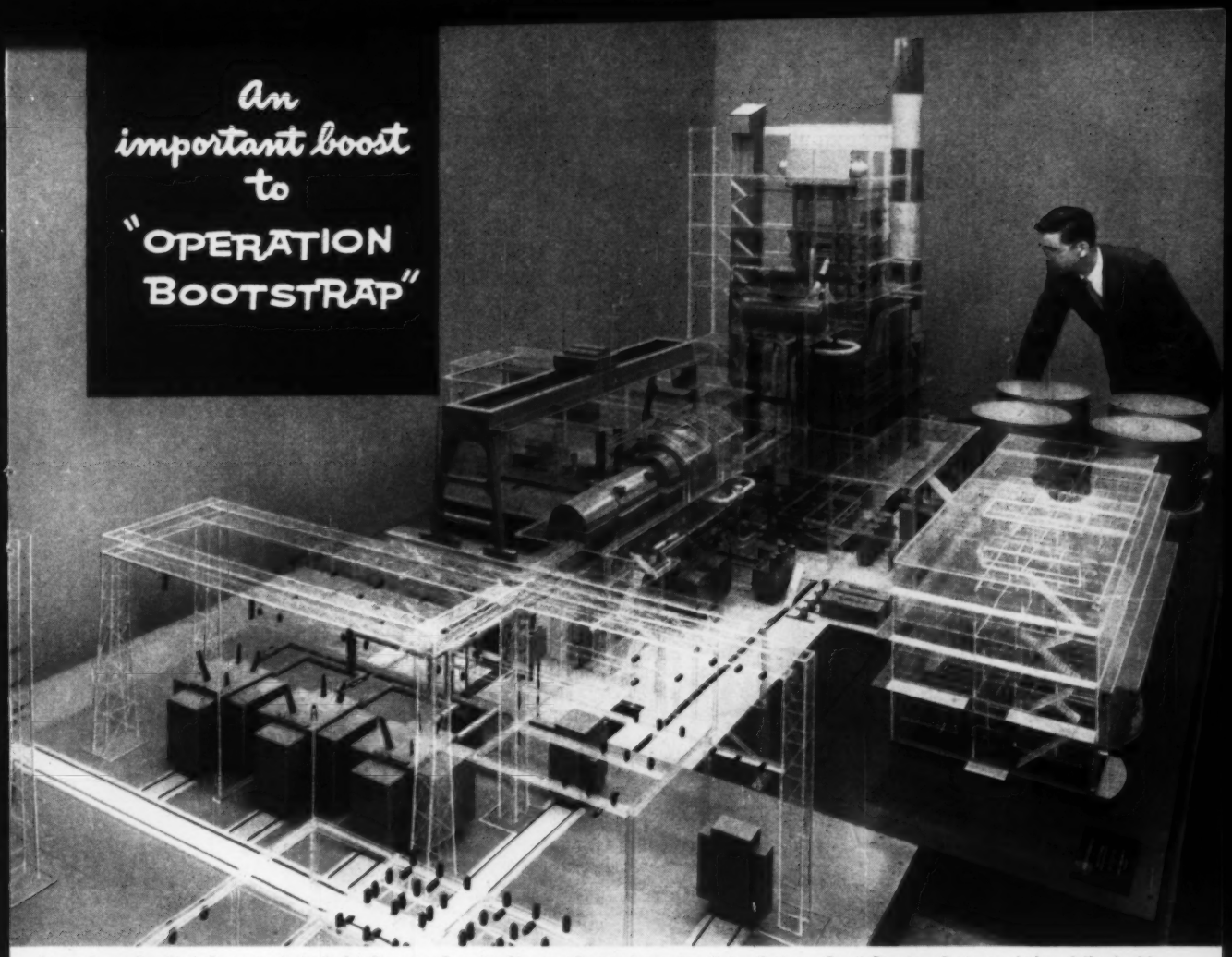
Model M-7WA

exploratory and core work in mining and construction. The rig has rated capacity in excess of 3,500 ft with 2⅞-in. pipe and 2,500 ft with 3½-in. pipe.

An outstanding feature is its wide hydraulically-operated mast, which has a working capacity of 50,000 lb and can handle 20-ft lengths of drill pipe. The mast is lowered for over-the-road travel.

The unit is equipped with a 600W air compressor, delivering 600 cfm at pressures up to 100 psi. The mud pump is a Wheatley Model 6070, piston type, 7 x 10 in. Operating power can be secured direct from the truck engine through a 500 power take-off, or by use of a separate power source.

Draw works are of the drum-over type. Capacity is 16,000 lb each. Drums carry 425 ft of ⅝-in. or 2,250 ft of ⅜-in. wire rope. Minimum effective brake area is 275 sq in. The 3-speed, heavy-duty rotary table has an 8-in. opening. Swing-out design permits setting of 30-in. casing without moving rig. **Davey Compressor Co., CE-11, Kent, Ohio.**



Owner–Puerto Rico Water Resources Authority, S. L. Descartes, Executive Director • General Contractors–Kaiser Engineers, Puerto Rico, Inc. • Designers–Jackson & Moreland, Inc.

Puerto Rico's new PALO SECO POWER PLANT ...another power project of

RAYMOND INTERNATIONAL

Low cost electric power plays a vital role in the success of Puerto Rico's exciting industrial development program "Operation Bootstrap." The newest addition to the island's mushrooming electric power system will be the Puerto Rico Water Resources Authority's 200,000 kilowatt Palo Seco Plant, near San Juan.

On this project Raymond, as subcontractor, will drive 2,430 Step-Taper Piles, totaling in excess of 150,000 linear feet for the plant's foundation. In addition, Raymond will construct the superstructure and allied structures, including intake channels and a rock jetty. Palo Seco will be the first "all outdoor" thermal-electric plant in Puerto Rico. This economical design, utilized so successfully in other parts of Latin America, has no walls–only a column-supported roof over equipment requiring protection from the elements.

Raymond is proud of its role, past and present, in helping Puerto Rico's power grow. Already in operation are six Raymond-completed units at the San Juan Steam Electric Plant and two at the South Coast Steam Electric Plant. The combined electric production at these eight units totals 270,000 kilowatts. But power plants are just one of the phases of Raymond's world wide activity. If you are contemplating construction anywhere, anytime, call on us. We'll be glad to show you if and how we can help.

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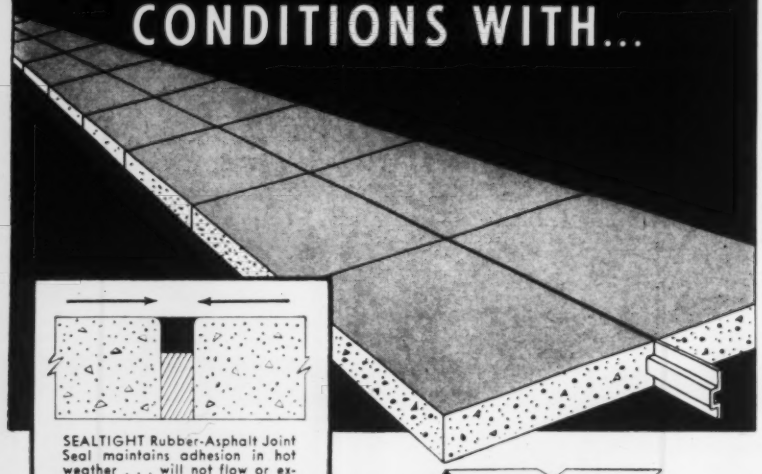
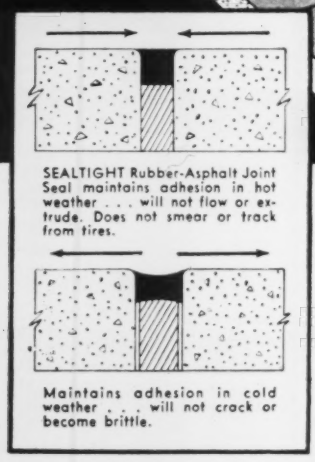
JOINTS MAINTAIN THEIR SEAL UNDER ALL WEATHER CONDITIONS WITH...




SEALTIGHT Rubber-Asphalt Joint Seal maintains adhesion in hot weather . . . will not flow or extrude. Does not smear or track from tires.
Maintains adhesion in cold weather . . . will not crack or become brittle.

SEALTIGHT

RUBBER-ASPHALT JOINT SEAL

RUBBER-ASPHALT JOINT SEAL compound available in both hot-pour and cold-applied types. SEALTIGHT Hot-Pour Rubber-Asphalt meets Federal Specifications SS-S-164 and CAA Specification P-605 ... SEALTIGHT Cold-Applied Rubber-Asphalt meets Federal Specification SS-S-159 and CAA Specification P-615. Both are ideal for use in the joints of concrete streets, highways, bridges, etc.

JFR RUBBER-ASPHALT JOINT SEAL is recommended for sealing concrete runways where resistance to jet fuel is necessary. Available in Hot-Pour Type to meet Federal Specification SS-S-00167 and Cold-Applied Type that meets Federal Specification SS-S-00170. Easy and economical to apply.

TONGUE AND GROOVE Joint, used primarily as a longitudinal joint, provides a "keyed joint" that assures maximum efficiency in load transmission ... helps to prevent blow-ups, spalling and controls cracking. Completely waterproof ... produced from asphalt hardboard ... is rigid, easy to handle and install, will not extrude. More economical and safer than steel center strips and will not rust away. Approved by Federal, State and Local engineering authorities.

EXPANSION JOINTS specifically designed to meet the needs of modern, properly-designed, properly-jointed construction projects. All types including Asphalt, Fibre, Sponge Rubber, Standard Cork, and Self-Expanding Cork joints available from "stock" at your local SEALTIGHT distributor. Meet Federal and State specifications.

SEALTIGHT rubberized-asphalt compounds provide the ideal sealer for years of economical, trouble-free joints in concrete construction. They feature high resilient and adhesive properties and are able to maintain a bond at below zero temperatures. Will provide a positive seal in all types of monolithic construction. Designed for use with non-extruding type fibre expansion joints.

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PRODUCTS

- EXPANSION JOINTS ... Asphalt, Fibre, Cork and Sponge Rubber.
- TONGUE and GROOVE Center Strip.
- Hot and Cold Rubber Asphalt Joint Seal.
- Hot and Cold JFR Rubber Asphalt Joint Seal.
- Air Entraining Agents.
- Curing Compounds.
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- "PREMOULDED MEMBRANE" Vapor Seal.
- "DURAJOINT" PVC Waterstops.
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Write today for complete information on the above products plus information about the many other top-quality SEALTIGHT products for highway construction ... ask for the "PAVING PRODUCTS" Catalog.

W. R. MEADOWS, INC.

20 KIMBALL ST. • ELGIN, ILLINOIS

EQUIPMENT MATERIALS and METHODS

(continued)

Aluminum Tripod

THE NEW "WELT" MODEL W-1000 All Aluminum Extension Tripod is made entirely of precisioned machined aluminum and is more portable, durable, lighter and easier to handle and set up than present ordinary wood tripods, the manufacturer states. It is color anodized for permanent weather protection and maximum visibility in the field. Legs extend to 58 in. and are reversible with rubber feet or spike point for use on all type surfaces; each leg has 2 locks and is easily adjusted. In addition to standard features of ordinary tripods, the "Welt" has an interchangeable instrument mount 3½ in. in diameter with 8 threads per inch. Weighing only 8½ lb, it is 4 to 5 lb lighter than ordinary tripods. Closing compactly to 36 in. for carrying, it needs no maintenance or refinishing, cannot split, warp, rot, crack, splinter, or stick. **Safe-Lock, Inc., CE-11, 870 W. 25th St., Hialeah, Fla.**

Centrifugal Pumps

A NEW LINE OF horizontally split-case single stage Centrifugal Pumps, known as Type S, featuring extremely quiet operation; short, compact overall dimensions; pre-lubricated bearings; and ceramic mechanical seals eliminating stuffing box drip and piping to drain, has been announced. The pumps are manufactured to precision standards, and include every latest engineering advancement to insure modern hydraulic and mechanical design. They are ideally suited for air conditioning, booster, heating, pneumatic water systems, refrigeration, and snow melting. **Chicago Pump Co., CE-11, 622 Diversey Parkway, Chicago 14, Ill.**

Point Design

OFFERING EXCELLENT PENETRATION AND long life in such tough formations as hardpan and tight river bottom gravel, the new point design was originally developed for ripping applications but is equally effective in bucket and shovel operations. The RDX point gives the machine operator a tooth with pick point penetration that lasts the life of the point.

In field tests, it has produced excellent results. Working in tight, abrasive formations, it produced one hundred and forty-one hours of sharp, penetrating service before being replaced. **Electric Steel Foundry Co., CE-11, 2141 N.W. 25th Ave., Portland 10, Ore.**

EQUIPMENT MATERIALS and METHODS

(continued)

Trains & Trailers

A COMPLETELY REDESIGNED AND engineered series of bottom dump hauling equipment, including lightweight and heavy duty semi trailers and trains, has been announced. Of special importance to earth-moving contractors is the fact that this equipment can be fully loaded "on-the-move" from belt type loaders in less than 15 sec; full loads are also unloaded "on-the-move" in less than 10-sec.

The foremost feature of the new series is the strong, rugged frame, which is constructed of square seamless tubing, said to withstand the stress and strain of hauling on or off the highway and severe shock loading conditions. The outer shell is made of a lightweight, high strength material. A lower silhouette permits easier loading and unloading in either a standing position or "on-the-move".

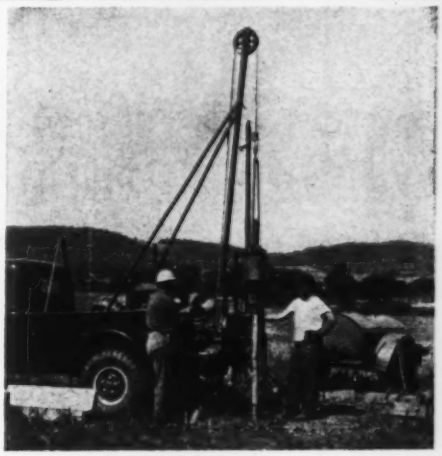
Strong, rugged frame

The semi trailer has a physical capacity of 35-ton payload for off-the-highway work. It will haul 20-tons or more, legally, on the highway. The lightweight bottom dump trains have a top payload capacity of 28 tons, legal in most states. Optional equipment is available for the "train" series for use in cement hauling and includes aluminum tops, butterfly gates and drop gates. **Cook Bros. Equipment Co., CE-11, 3334 San Fernando Road, Los Angeles 65, Calif.**

Rotary Drilling Rig

ESPECIALLY DESIGNED FOR USE by the mining, quarry, highway, and construction industries, the new portable rotary drilling rig is recommended for drilling blast hoes, taking cores, soil sampling and other foundation work. The unit is mounted on a GF-660 Crane Carrier truck with a GMC 4-71 diesel engine which furnishes power for the rotary table. The air compressor is a Le Roi model 100-S2, powered by a GMC 6031-C diesel engine, with hydraulic full load governor. The rig uses both conventional type rock or drag bits and also the down-the-hole tools which are recommended for extremely hard formations. Three hydraulic leveling jacks are standard equipment on the unit. **George E. Failing Co., CE-11, Enid, Oklahoma.**

DEPENDABLE SOIL SAMPLING EQUIPMENT IS NO PROBLEM FOR THIS DRILL CREW



With a contract to obtain representative samples of the soil strata along the center line of an important link on the new Interstate Highway System, this contractor is using the S&H Split Barrel Sampler for recovering samples in this immediate area. At the next location, sampling for a bridge foundation, the S&H Shelby Tube Sampler will be utilized to recover the undisturbed samples that are necessary.

Sprague & Henwood's sampling equipment is designed for long, dependable service with a resulting minimum cost. The complete line of sampling devices and equipment is described in the new Bulletin 300.

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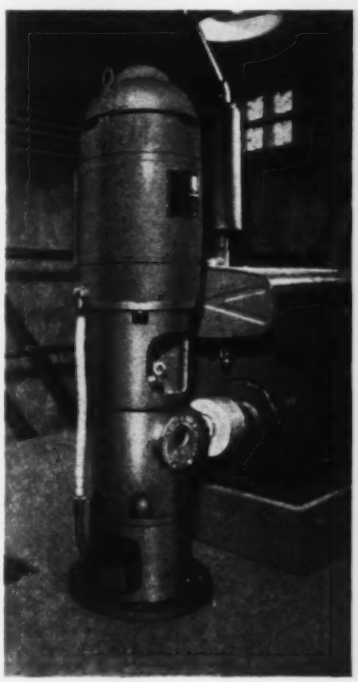

Cross State Development Co. installed the Johnson combination drive shown here in a sewage disposal plant in Florida. They report: "It's recognized as one of most efficient, packaged systems in the Tampa area. We've never experienced any difficulty." Neither will you because Johnson combination drive assures engine take-over the instant electricity fails. Either power unit may be overhauled without interrupting service.

Sizes: 15 to 450 hp. Johnson Right Angle Gear Drives are available in combination, dual and standard types; for all horizontal prime movers; hollow or solid shaft. Please write for engineering catalogs.

7-R

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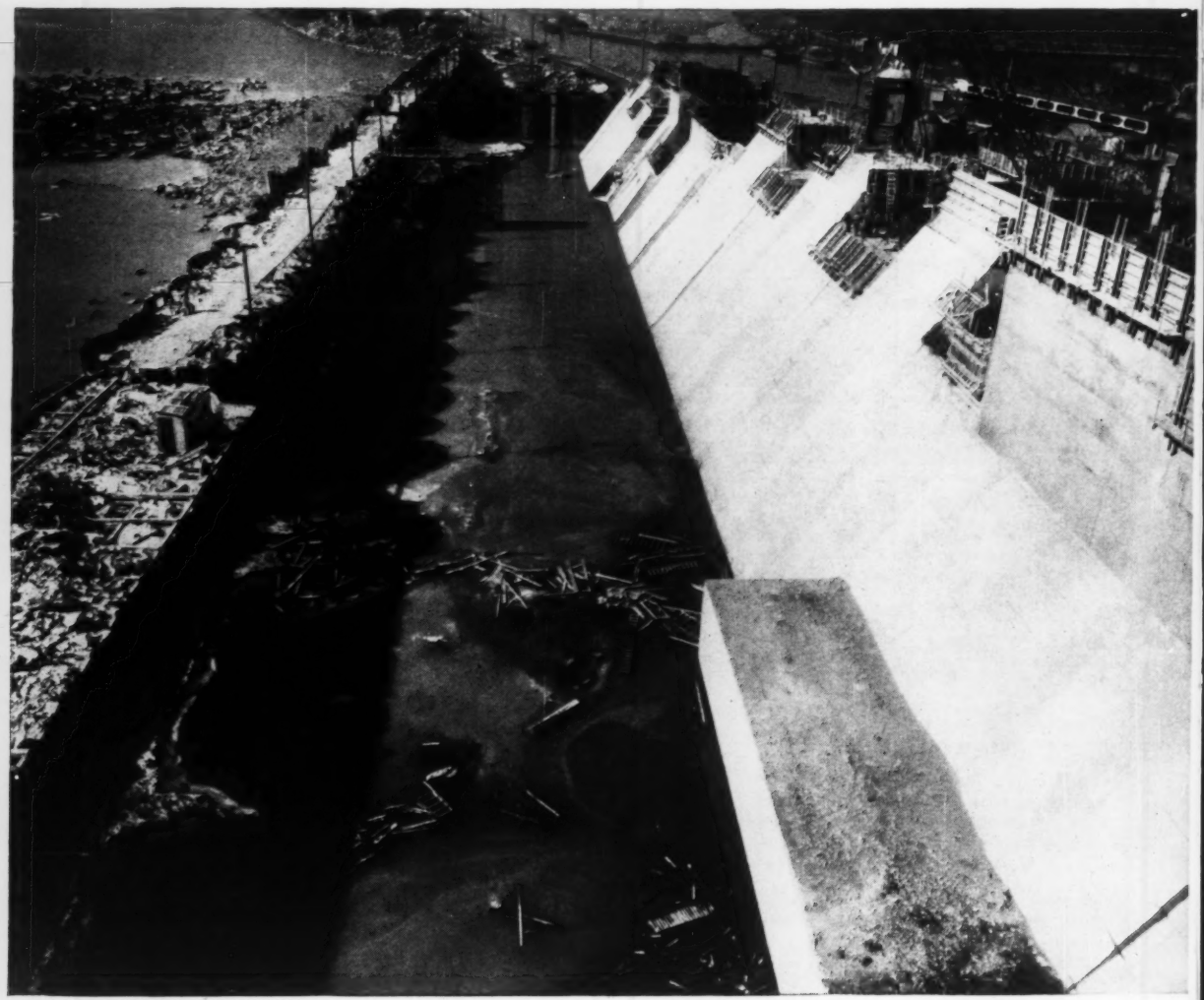
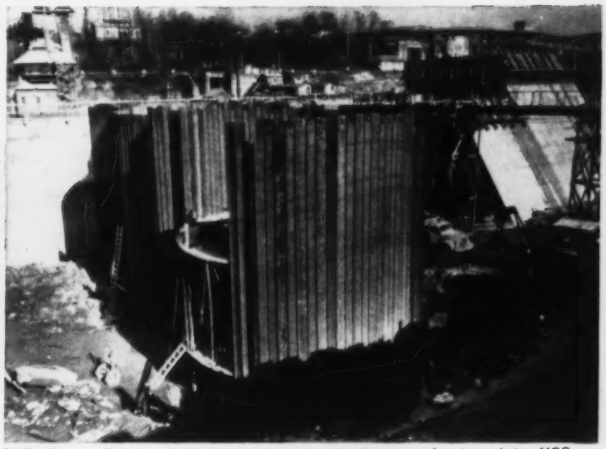
World's highest single-lift lock built with USS Steel Sheet Piling cofferdams



Downstream view showing new Wilson Lock with cofferdam A at left and E at the far end of the lock.

View showing the new temporary canal in use with cofferdam F in background shutting off the entrance of the old canal while it is being deepened by 10 feet.



Cofferdam cell being built on solid rock with the use of a template. USS MP-101 Straight Web Piling assures maximum strength in tension.

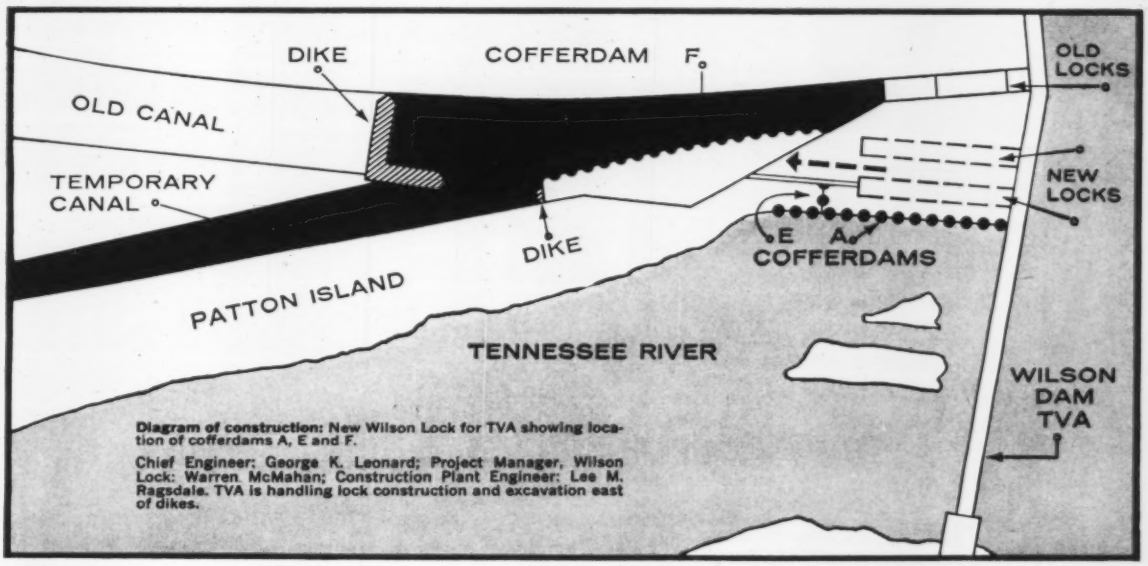


Diagram of construction: New Wilson Lock for TVA showing location of cofferdams A, E and F.

Chief Engineer: George K. Leonard; Project Manager, Wilson Lock: Warren McMahan; Construction Plant Engineer: Lee M. Ragsdale. TVA is handling lock construction and excavation east of dikes.

TVA's new 100-foot-high Wilson Lock at Muscle Shoals, Alabama will have the distinction of being the world's highest single-lift lock. The $35 million construction project includes a 110 x 600 ft. lock chamber through the existing dam, 4 million cubic yards of canal excavation, and a high-level fixed span bridge over the huge lock.

It is quite an engineering feat to construct a new lock through an old dam without interrupting navigation more than a few days. The first two cofferdams, A and E, were built to keep the Tennessee River out of the new lock area. These took a total of 32 cells, each 36.61 feet in diameter, with the USS MP-101 Straight Web Piling ranging from 38 feet to 48 feet in length. The cofferdams were set on rock; consequently, there was no penetration. It took an average of three days to construct and fill each cell.

Another cofferdam, F, was built to direct the flow of water into a new temporary canal through Patton Island and to dry up the old canal which will be made 10 feet deeper. The 58 cells in this cofferdam are 23.88 feet in diameter and are also set on rock. The piling is all in 20-foot lengths of USS MP-101. There was no penetration, and the cells were constructed and filled on an average of one per day.

A total of 3,953 tons of USS MP-101 Straight Web Piling was used for these three cofferdams—and all of it was delivered on schedule. For the new bridge (not shown), USS H-Beam Bearing Piles were used. This is another case that illustrates the excellent deliveries made possible by U. S. Steel's large production facilities and attention to customers' needs. When you want any type of piling—steel sheet piling or H-Beam bearing piles—call the United States Steel office near you.

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CONSTRUCTION

ANALYSIS OF GROUND-WATER PROBLEM AND PRE-BID DEWATERING ESTIMATE WITHOUT OBLIGATION

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EQUIPMENT, MATERIALS and METHODS

(continued)

Valvmatic

INSTALLED VALVES CAN BE converted from hand-operation to electric motor operation with a low cost conversion unit, installed without special engineering, disturbing piping or replacing existing valves. Valvmatic operates with complete safety.

Normal installation consists of six easy steps which plant labor can perform with ordinary tools. The machine can be used in nearly every application where the valve handle does not rise, and where the handle can rotate when the valve is operating under power. In the event of power failure, the valve can be restored to manual operation by removing two pins.

Position and torque limits are provided in both directions of rotation to prevent valve injury. Valvmatic can be moved from one valve to another, and no special wiring is needed. It is not necessary to remove the valve from the line to install the unit, nor is machining of special valve nuts involved. **C. H. Wheeler Manufacturing Co., CE-11, 19th & Lehigh Ave., Philadelphia 32, Pa.**

Bridge Bearing Pads

BRIDGE ENGINEERS AND CONSTRUCTION companies can now obtain neoprene bearing pads made to a new formula. Placed between the bridge's abutments and girders, they will accommodate expansion, contraction, and rotary movements without shifting because of their ability to deflect in shear. High tensile strength, minimum compression set and hardness stability characterize this material, which is also highly resistant to the effects of sunlight and weather. The cost is approximately 25% of conventional bearing assemblies. **Hamilton Rubber Manufacturing Corp., CE-11, Trenton 3, N. J.**

Galvanized Floor Clips

DESIGNED TO LAY FLOORING in large dining rooms, dance halls, schools, and commercial buildings, the new galvanized steel clip is made with perforated, embossed tabs that are imbedded in the moist concrete floor deck and include fold-down tabs designed to be bent upright and accommodate "sleepers," which are then leveled up and nailed to the clips through prepunched holes in the protruding tabs.

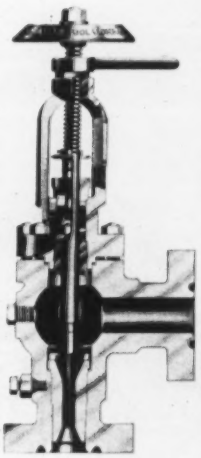
Since tabs are set in moist concrete as the first step in the floor laying operation, corrosion of the metal is a critical factor of service life. The manufacturer selected galvanized steel because of zinc's inherent resistance to corrosion—protection that works both mechanically and electrochemically. Thus floors of superior service qualities can be laid with great economy—floors that are perfectly rigid, with problems of buckling, warping and dry rot virtually eliminated. The clips are .040-in. thick by 1-in. wide to accommodate 2-in., 3-in., and 4-in. wood sleepers and are made from 20-gage 1-in. wide steel cores galvanized by the continuous hot dip process.
Bull Dog Floor Clip Co., Div. of New Monarch Machine & Stamping Co., CE-11, 406 S.W. Ninth St., Des Moines 9, Iowa.

Throttling Valve

A NEW LARGE, HIGH pressure throttling valve for general industrial and chemical use is now being manufactured.

This metering valve has many features which make it ideal for accurate fluid or gas control. Outside threads give corrosion resistance and the stem may be locked at any setting. A pointer and calibration plate indicate the amount of orifice opening. A tapered throat gives a venturi tube effect with excellent flow characteristics.

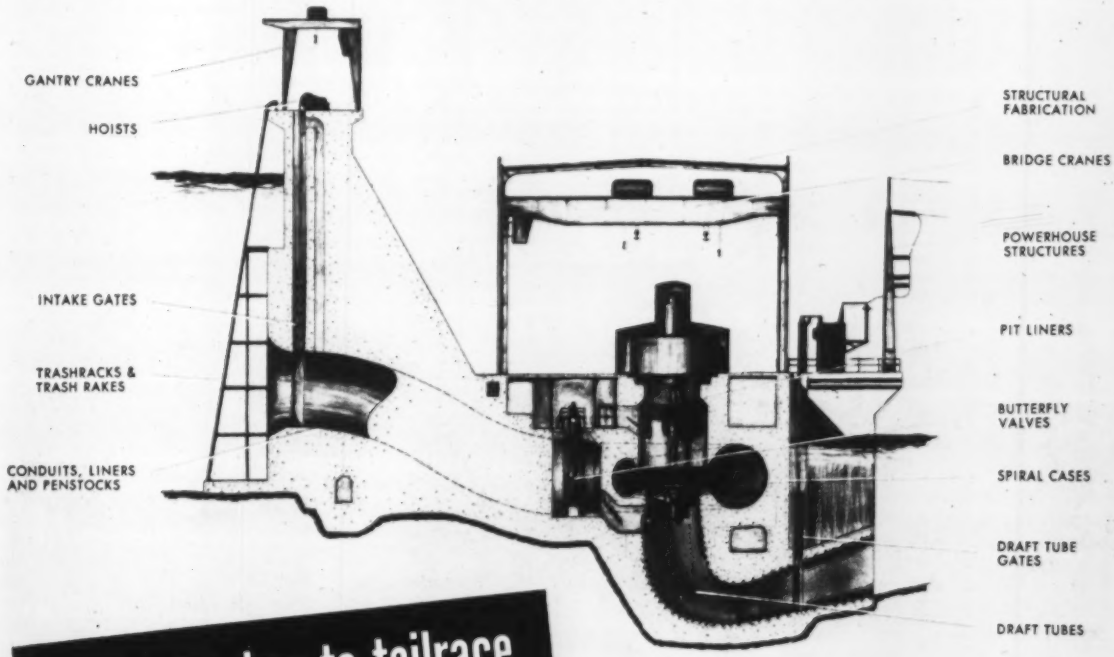
Available in ASA or API flanged or threaded connections, this valve is made



Ideal for Fluid or Gas Control

in carbon steel, stainless steel, bronze or aluminum. It is manufactured in sizes 1 in. to 6 in. and in pressure ratings to 10,000 psi in all sizes.

Several interchangeable tips are manufactured: conical, micro tip (which gives equal changes of orifice area for equal stem travel), thermo tip (which has an internal heating element in the tip), and extra-hard metal tips for special abrasion resistance. Fixed diameter chokes are available in all sizes. Automatic actuation by hydraulic or air pressure is available on all valves. **Shaffer Tool Works, CE-11, 209 S. Pomona, Brea, Calif.**



from forebay to tailrace —from design to erection

Your investigation will *prove* how Yuba's ability to design, fabricate, machine and erect anywhere in the world is backed by decades of experience, know-how of skilled personnel, and complete production facilities.

From forebay to tailrace—from design to erection, Yuba handles the complete job as a package responsibility. This relieves both user and contractor of the need for coordinating production, delivery and installation. Ask for Bulletin No. HY-51, describing Yuba's hydroelectric equipment and services, or ask for sales engineer to call.

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ALL ALUMINUM
TRIPOD
PRECISION ENGINEERED FOR HEAVIEST DUTY, THE ALL NEW
The Safe-Lock WELT MODEL W-1000
ENGINEERS EXTENSION TRIPOD
At last an entirely new Engineers' tripod replacing the ordinary heavy troublesome wood and bronze tripods! Much easier to carry and set up . . . actually weigh 4 to 5 pounds less than old style tripods. Needs no maintenance or refinishing, can't split, warp, rot, crack, splinter or stick!
Double Lock Knobs Close 5-inch Long Collet For 360-Degree Grip On Leg Extension
Interchangeable instrument mount (3½" 8 Thd.) Fits all standard instruments. (Other sizes available.)
Height closed 36"
Legs extended 58"
Weight 8½ lbs.
Construction: Aluminum castings with Aluminum reversible tubular legs, fittings. Finish: Anodized in high-visibility colors, resistant to all weather.
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EQUIPMENT MATERIALS and METHODS

(continued)

Bronze Alloy

COMBINING BOTH HIGH YIELD strength and high ultimate tensile strength even at elevated temperatures, this corrosion-resistant nickel-silicon-bronze alloy is age hardened and is available in soft, cold forming, and hard tempers. Silnic Bronze in the cold forming (solution annealed and drawn) temper permits easy material flow for fabrication involving severe or complicated cold working. Subsequent age hardening gives the final high strength, hardness, and conductivity to the nickel-silicon-bronze alloy. It will not age-harden spontaneously at storage temperatures.

Purchased in the hard temper, the bronze can be machined or given moderate cold working without further treatment. It gives extremely good chip breakage and accurate detail when machined. The alloy has about five times the electrical conductivity of bronze alloys presently used for high strength, high corrosion applications; it is free from silicon segregation, with its resultant planes of weakness, which is common to high-silicon bronzes; and it has uniform distribution of strength and hardness through its entire cross section, with identical properties for the whole range of sizes. **Chase Brass & Copper Co., CE-11, 1949 Rodney St., Waterbury 20, Conn.**

Drafting Medium

A TEAR-PROOF DRAFTING medium of unequalled permanence with unique drafting qualities has been announced. According to exhaustive laboratory tests, the Ageproof Film withstands usage that would destroy any other drafting media. Repeated erasures, folding and handling have virtually no effect on the drafting surface.

Made from an inert Dupont Mylar base, the material has a tensile strength of 20,000 psi, tensile modulus of 550,000 psi and a flex-life of 20,000 cycles. It is completely fungus-resistant, impervious to perspiration, water and soft drink spots.

The transparent, fiber-free structure insures extra sharp and legible reproduction with just the right amount of transparency for visual comfort on the drafting board and maximum contrast for reproduction.

The film is also available with diazo and photo-type sensitized surfaces, thus providing an efficient and economical way of obtaining print copies with all the amazing properties of Ageproof Film. **Dept. CE-11, Eugene Dietzgen Co., CE-11, 2425 N. Sheffield Avenue, Chicago, Ill.**

HI-HED® solves a weighty problem!

Twin lines of 120-inch precast Hi-Hed Reinforced Concrete Pipe installed to support 13 feet of backfill and a Cooper E 60 railroad loading. Union Carbide Chemicals Company was thus able to utilize two additional acres of valuable land at its South Charleston, West Virginia Plant.

- Hi-Hed Reinforced Concrete Pipe will support as much as three times the field load of equivalent round pipe.
- The elliptical shape of Hi-Hed Pipe results in self-cleansing velocity at low flow.
- Smooth precast concrete assures maximum capacity at high flow. High density minimizes abrasion.
- Investigate the other time-saving, money-saving benefits of Hi-Hed Pipe.

Full range of sizes in equivalents of round pipe diameters 18" through 144".

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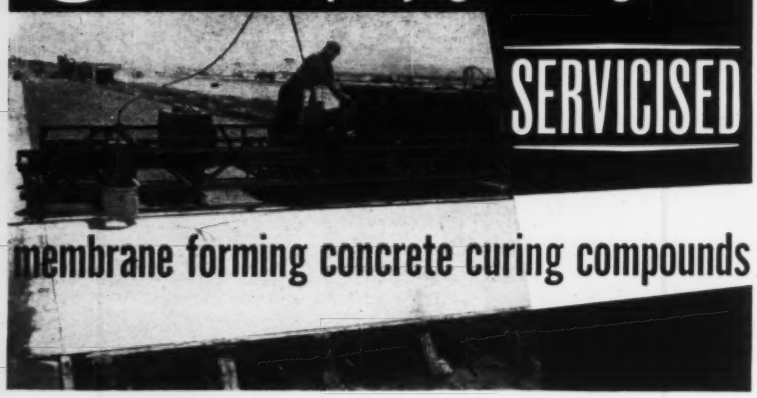
6 reasons for specifying and using SERVICISED membrane forming concrete curing compounds



1. Provide lowest unit of moisture loss
2. Meet official specifications for each particular type
3. Sprayed or painted on vertical surfaces, they will "stay put"
4. Save time, labor, material
5. Will not cake in the drum
6. Guaranteed uniform quality and results

WHITE PIGMENTED TYPE Servicised White Pigmented Curing Compound provides a film or membrane capable of reflecting heat. It is widely used in areas where atmospheric temperatures exceed 80°F., and properly applied, will reduce concrete temperatures approximately 15°F. Excessively high temperatures during the early hardening period tend to jeopardize setting of concrete and reduces its final strength. High quality inert pigments added to the basic compound also prevent too thin or uneven coverage, as improper application is readily seen. Used on all U. S. Engineers work.

CLEAR TYPE Servicised Clear Curing Compounds are available in both Wax-Resin and Resin Base Types. Only pure synthetic resins are used with carefully controlled proportions of oils and waxes, etc., in a petroleum solvent to insure a clear, impermeable membrane. Both types can be supplied with a fugitive dye which materially assists in securing proper coverage, and which disappears after application.

WAX-RESIN BASE. A general purpose compound, usually used on mass concrete, pavements. Has excellent water retention properties, allowing slow curing of the concrete which eliminates checking. Dries rapidly and forms a film of uniform texture.

RESIN BASE. Recommended for buildings, offices, architectural concrete, etc. The pure resins, oils and other ingredients present a clear film which does not materially alter the appearance of concrete and it permits early application of adhesives, paint, etc.

AIR ENTRAINING AGENT Servicised Air Entraining Agent is a highly active, homogenous and clear solution. A relatively small quantity produces maximum air dispersion, yet it is not so critical as to create wide fluctuations in the amount of entrained air should slight variations in the amount used occur. It will not settle out in storage or gum the dispenser, and its action is not jeopardized by the presence of Calcium Chloride. Servicised Air Entraining Agent meets all official specifications, comes ready to use and requires no additional ingredients or treatment before being used. Available in 5 gallon and 55 gallon drums.

Write for special circulars on Curing Compounds and Air Entraining Agent

SERVICISED PRODUCTS CORPORATION
6051 WEST 65th STREET • CHICAGO 38, ILLINOIS

EQUIPMENT MATERIALS and METHODS

(continued)

Thrust Boring Machine

Powered by a 50-hp gasoline engine, this machine consists of a rotary cutting head, driven by a cutter bar and a spiral conveyor which carries the earth displaced at the "face" back through the lining and deposits it behind the machine. The cutting head operates immediately in front of the leading edge of the culvert liner tube, which is drawn forward as the cutter removes the soil by a winch geared to synchronize earth removal and linear advance. The machine is saddle mounted on the culvert liner and secured to it by twin girths. As the cutter head bores into the earth, the winch pulls the liner into the cavity which has been formed. As a result of this system of close and progressive lining, there is no possibility of subsidence.

The boring capacity is from 24 to 42-in. in 2-in. stages, and the normal limit for a length of culvert is 200-ft, according to the diameter of pipe and type of ground. It can bore through any substance but solid rock, and can handle boulders smaller than the internal diameter of the pipe. The rate of boring depends on the type of substance encountered but, in favorable conditions, a progress rate of one foot per 2 to 3-min is normal. **Costain-John Brown Ltd., CE-11, 73 S. Audley St., London W. 1., England.**

Structural Fiberglass Tubing

Already utilized in the design of fiberglass highway structures, antenna masts for land and maritime use, utility poles and a variety of conventional products, the new, structural fiberglass tubing is produced in a number of types, diameters and lengths. Incorporating fiberglass and petroleum resins by use of a process developed by the company's engineers, the tubing is impervious to soil chemicals, weathering and extremes of temperature and light. Couplings and fittings, made of pressure-laminated fiberglass, have also been developed for use with it. **Gar Wood Industries, Inc., CE-11, Garwood Sq., Wayne, Mich.**

Corrugated Metal Pipe

There is a size, gage, shape and type of pipe for practically every drainage need, the manufacturer states. Plain galvanized is used for normal service; Paved-Invert combats erosive flow; and Asbestos-Bonded is employed for severe corrosive service. The advantages of this pipe include flexible corrugated strength, durability, long, lightweight lengths, strong, positive joints, and simple, quick installation. **Armco Drainage & Metal Products, Inc., CE-11, 703 Curtis St., Middletown, Ohio.**

Ten-ton Blaw-Knox bridge deck form moves on traveler to new position. Steel chains for fir gates are cast integrally with girders. Old River Control Project is a $47 million job designed to preserve Mississippi's flow into its lower basin.

Blaw-Knox steel forms cut costs, simplify concreting operations on Old River Control Project

Blaw-Knox multi-purpose bridge deck forms used in the construction of the Overbank Control Structure on the Old River Control Project near Simmesport, Louisiana amortized their cost for F&C Engineering Company, prime contractors on the huge project, less than three-quarters of the way through the job.

A three man crew strips and moves the form into position in less than a day. Six additional men align the form and position girder and curb forms which are fabricated on the ground and raised by crane. To date, F&C has averaged one pour every third day.

With this kind of performance, it is easy to see why F&C expects to complete concreting ahead of schedule, at the same time cut job costs. The number of skilled carpenters is greatly reduced, along with material requirements. In your next concrete project, whatever its nature, call in the Blaw-Knox Steel Forms Consultation Service to help in planning for more efficient forming, lower costs, better job profits. There's no obligation, of course.

BLAW-KNOX

BLAW-KNOX COMPANY

Blaw-Knox Equipment Division
Pittsburgh 38, Pennsylvania
STerling 1-2700

EQUIPMENT, MATERIALS and METHODS

(continued)

Tournapull

HORSEPOWER HAS BEEN INCREASED to 335 and capacity has been boosted to 21-yd struck and 28-yd heaped on the Model B Tournapull. The standard engine is a Cummins six-cylinder, four-cycle diesel with a high volume, high efficiency turbocharger. The combination of this turbocharger and a newly designed ground gear, precision flow fuel pump provide the engine with superior acceleration characteristics.

The power increase is reflected in higher speeds. The Model B with standard step gear transmission is now capable of low range speeds up to 20.7 mph while in high range, top speed has been increased to 30.1 mph.

An increase in horsepower is also announced for the optional G.M. Detroit Diesel six-cylinder, two-cycle engine which is available in the Model B. According to the engineers, this engine, a 325-hp unit, "breathes easier" than the two-cycle one which was previously available for the "B". To provide this improved "breathing" the size of intake ports in cylinder linings have been substantially enlarged and the number of exhaust valves increased from 2 to 4 per cylinder.

Power Increase

Boosting the struck capacity of the scraper by nearly 2 cu yd (from 19.1 to 21) was accomplished by making only minor modifications, which in no way disturb the easy loading characteristics for which the design has become noted. **LeTourneau-Westinghouse Co., CE-11, 2301 N. E. Adams St., Peoria, Ill.**

Water Reducing Agent

A NEW CONCRETE WATER REDUCING agent that gives maximum water reduction, higher strengths and better cement dispersion in all types of mixes has been developed. This concrete additive, PDA (Protex Dispersing Agent), gives field proven economy in all phases of concrete placement while meeting rigid government specifications. Over 100,000-cu yd of concrete with PDA were recently placed by Harrison Engineering on their U.S. Naval (Buckley) Air Force project in Denver, Colorado with completely satisfactory results reported. Specifications requiring flexural strengths of 600-lb in 28 days and a minimum of 7 sacks per cu yd were changed to permit a lower cement content; providing a water reducing initial retarder was used and the identical end results were obtained. Concrete was placed with 6 sacks per cu yd and ¼-lb of PDA per sack which permitted a 20% reduction in the unit water content. This mixture gave flexural strengths of over the required 600-lb and achieved this in only 14 days. **Autolene Lubricants Company, CE-11, Denver, Colo.**

Electronic Computing Service

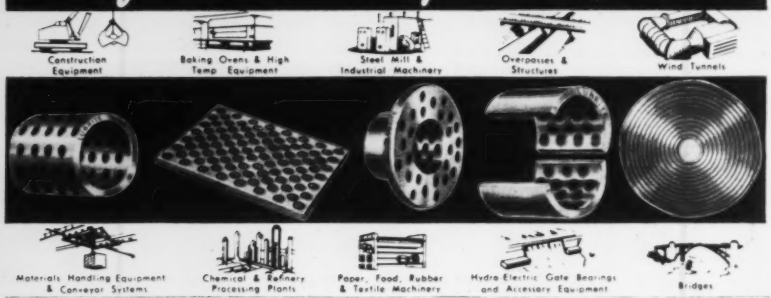
SO THAT ENGINEERS CAN have the speed and economy of today's electronic computers without having to install equipment, a nation-wide service designed to help on design and development problems, on a low-cost hourly or job basis, has been offered. The country's oldest and largest independent punched-card tabulating service bureau, it maintains complete facilities, together with the services of qualified mathematicians and technicians, to provide quality service for fast, accurate calculations. A complete library of "packaged" programs is available at no extra cost, to give engineers the advantages of the company's experience on many types of applications, for time and money savings. Typical applications of this electronic computing and data-processing service include survey traverse, cut and fill, moment distribution, truss analyses, linear programming, network analyses, pipeline analyses, transportation problems, curve fitting, matrix inversions, core analysis calculations, etc. **Statistical Tabulating Corp., CE-11, 53 W. Jackson Blvd., Chicago 4, Ill.**

Concrete Bonding Agent

THIS PATENTED, JOB-PROVED liquid bonding agent enables a person to permanently bond new concrete or cement plaster, directly to any other structurally sound surface, no matter how smooth.

There is no costly, time-consuming, surface preparation, for you just apply Weld-Crete, let it dry and pour or trowel the new concrete. It has equal bonding permanence all climates, all surfaces, and all sorts of conditions. When used with quick setting cement topping, floors, ramps and driveways can be laid one day and heavy truck traffic run over them the next. **Larsen Products Corp., CE-11, 4934 Elm St., Bethesda, Md.**

ASSURED SELF-LUBRICATING SECURITY WITH LUBRITE® Self-Lubricating BEARINGS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TIDE GATES

Figure B-175. Type M-R Gates designed especially for application to centrifugal pump discharge lines. A rubber seating ring is inserted in the seat to absorb the slap which occurs when pumps stop. A flexible bar connection is arranged between the hinge links to provide a stop for the gate shutter to prevent the outer edge of the shutter from tipping downwardly when flow abruptly ceases. Smaller sizes of gate are provided with a bumper arrangement to prevent the shutter being forced too widely open when flow starts.

Ask for Bulletin 73A

BROWN & BROWN, INC.
LIMA, OHIO, U. S. A.

EQUIPMENT MATERIALS and METHODS

(continued)

Method for Determining Rock Depth

A NEW TECHNIQUE FOR locating rock without the necessity for drilling has been announced. Using sound waves in the earth produced by an impact on the ground surface, the MD-1 Refraction Seismograph permits determination of depth to bedrock with an accuracy of 5-10%, or alternatively permits determining whether or not rock exists within any specified depth to 50 ft or more. Simple rapid operation offers the civil engineer a means for obtaining subsurface information with major cost reductions. **Geophysical Specialties Co., CE-11, 15409 Robinwood Drive, Hopkins, Minn.**

Portable Arbor Press

THE CAKING CHARACTERISTICS OF powdered materials can now be determined by a 7-lb Arbor Press, which measures only 11 inches high.

The new unit features a Mechanical Force Gauge with red maximum pointer, placed upon the lower platen of a press, directly beneath a removable ram. For checking powdered materials, a cylindrical cup is mounted to the gauge; it has a removable inner ring which may be filled with fertilizers, chemicals, medicines or other powdered materials. Once filled, the ram of the press is lowered and force is applied to specification. The inner ring is then removed, leaving a compressed pellet of the desired size. The final test load is brought to bear against the pellet until it crumbles, thus giving exact knowledge of the caking characteristics of the material under different conditions of moisture and temperature. **W. C. Dillon & Co., Inc., CE-11, 14620 Keswick St., Van Nuys, Calif.**

Dowel Basket Assemblies

THESE HEAVY DUTY UNITS, manufactured in three basic types, are expansion joint, impressed contraction joint, and sawed contraction joint.

Available for use with any thickness of slab, the Sure-Grip assemblies are manufactured to exact specifications; sand plates are optional. Special manufacturing methods assure maximum strength and accurate alignment of dowels, which remain firmly in place during pouring and finishing.

With the exception of the expansion core or impression plate, the units are completely assembled at the plant. Because they nest easily, the assemblies are easier and more economical to ship and store. **Dayton Sure-Grip & Shore Co., CE-11, Kercher St., Miamisburg, Ohio.**

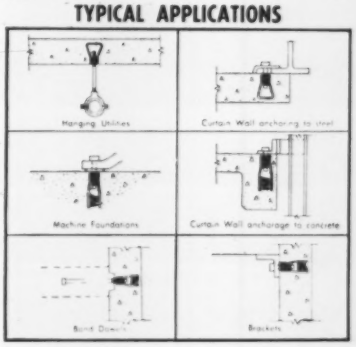
New Richmond Structural Concrete Inserts

With sufficient strength and safety for permanent fastening to concrete.

Available in ½" to 1½" diam. in strengths to 65,000 lbs. in 3,000 psi concrete

The *new* Richmond Structural Concrete Inserts are prefabricated from a special design which distributes the bolt stresses into the concrete for greater strength than any previously known device. Certified tests of these units in concrete at 3,000 p.s.i., verify this claim and permit design engineers to approach the problem of fastening appurtenances to structural concrete with greater security than has been possible in the past.

TYPICAL APPLICATIONS



The new Richmond Bulletin on Structural Concrete Inserts gives you complete information about these inserts and their varied uses. Send for it and the Richmond Handbook showing the full line of Tying Devices, Anchorages and Accessories for concrete construction. Write to:

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816-838 Liberty Ave., Brooklyn 8, N. Y.
or 315 South Fourth St., St. Joseph, Mo.

(continued)

Structural Load Tests

USING DEEP FORMED STEEL and cellular concrete, structural load tests have been successfully completed on a lightweight fire-resistant roof system.

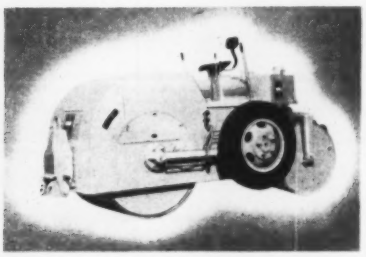
Test slabs using Poretherm cellular concrete which acts as insulating fill and galvanized Corruform and Tufcor which serve as the structural deck, were load tested to ultimate failure. All of them were set up with a two-span condition simulating actual roof construction. The slabs consisted of Standard Corruform with 4-ft spans, 26 gage Tufcor with 6-ft spans and 24 gage Tufcor with 8-ft spans, each one covered with a 2-in. Poretherm fill.

The results: The Standard Corruform slab failed at 7.4 times design load, the 24 gage Tufcor slab at 5.6 times design load, and the 26 gage Tufcor slab supported a load of 8.5 times design load at which time the test was terminated. All slabs were designed for a live load of 40 lb per sq ft. These tests verify the acceptance of this type of roof construction used in commercial and industrial buildings. **Granco Steel Products Co., CE-11, 6506 North Broadway, St. Louis 15, Mo.**

Tandem Roller

A 4-6 TON RETRACTABLE WHEEL roller has been added to the tandem line. This new unit offers one big distinct advantage and that is maximum portability. In three simple steps it is easy to convert the equipment from working to transport position for fast movement from job to job. The retractable wheels and towing hitch are operated by a power hydraulic system.

The tandem has the exclusive feature of a tail-shaft governor, combined with a torque converter and water-cooled engine. Other features include: a foot operated disc-type brake located on the transmission output shaft; variable speed steering valve; extra large 34-in. diameter guide roll; and easily removed kingpin housing for replacement.



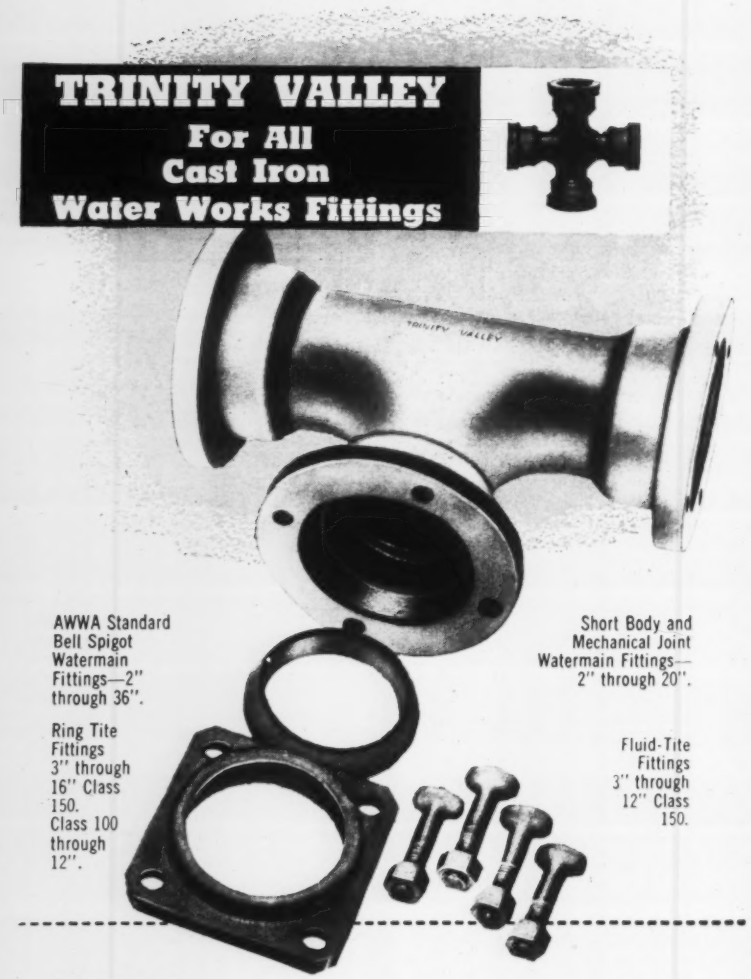
Maximum Portability

Because of the balanced weight design, there is only 1,280 lb riding on the towing vehicle. From 17 to 21% less weight on the hitch results in better towing action at higher speeds. There is an 8-in. verticle adjustment at the hitch for level travel. Lock pins, not the hydraulic system, carry the load during travel.

The engineering design provides complete safety. As hydraulic controls are located on the side of the machine, there is no need to climb on the deck. **Huber-Warco Co., CE-11, Marion, Ohio.**

Lift Truck

THE NEW 6000-LB CAPACITY fork lift truck designed for operating over rough terrain and handling high lift operations features four-wheel drive, power steering, power booster brakes and tilting telescopic tower. It is powered by a Hercules Model DD-298 six-cylinder diesel engine, which develops 85 hp at 2000 rpm and has a full reversing shuttle transmission. **Lull Engineering Co., CE-11, 3405 Highway 13, St. Paul 11, Minn.**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EQUIPMENT MATERIALS and METHODS

(continued)

New Trencher

THE FEATURES OF THE Model M-2 Ditch Witch trencher include a new 8-in. width trencher to 30-in. depth, also 6 x 36-in., 4½ x 36-in. and 3 x 48-in. New speed reduction unit with Select-O-Matic shift from digging speed to mobile speed provides four speeds forward and reverse.

Among the optional features available is a sod cutting attachment which can be mounted on the trencher in minutes and cuts an 8-in. sod strip at speeds up to 40-fpm. After trenching and backfilling sod can be replaced, leaving turf with an untouched look. **The Charles Machine Works Inc., CE-11, 608 Birch St., Perry, Oklahoma.**

Mobile Batching Plant

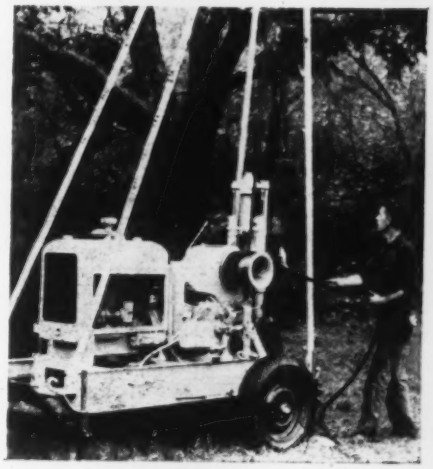
PRODUCING CONCRETE IN AN untested area with a batching plant on wheels proved the practical way to confirm sales forecasts and profit-poter tial before investing in a permanent plant. San Gabriel Ready-Mixt, Pasadena, California, moved into the Inglewood area with a 125-cu yd per hour mobile plant on the basis of a rush contract for freeway paving while anticipating planned airport and industrial construction. Within 90 days, demand had substantially exceeded original estimates. Confident that big contracts based on quality controlled concrete and reliable delivery could be secured even against entrenched competition, San Gabriel rushed to completion the installation of a stationary plant. Producing upwards of 125-cu yd per hour, this plant has overhead storage for 150 tons of aggregate in four sizes and separate overhead storage for 450 barrels each of two types of cement. Under construction is a 260-ft long combination cement screw and air slide from a rail siding. Six underground hoppers store a total of 1,000 tons of aggregate. **The Noble Company, CE-11, 1860 Seventh Street, Oakland, Calif.**

Seamless Concrete Slump Cone

SLUMP TESTS ON CONCRETE can now be performed more efficiently with a new seamless Slump Cone made of heavy gauge cadmium plated sheet steel. The handles and foot clamps are welded in position and are also cadmium plated to resist rust.

The cone is made in form of a fustrum of a cone with a 8-in. dia open base and a 4-in. dia open top; the height is 12 in. It is used for measuring the slump of Portland Cement Concrete in accordance with ASTM Specifications C-39, C-143, C-192 and AASHO designations T-22, T-119, and T-126. **Soiltest, Inc., CE-11, 4711 W. North Ave., Chicago 39, Ill.**

ACKER DUAL-PURPOSE CORE DRILL AIDS FEDERAL HIGHWAY PROGRAM



Acker gives you more for your money because the essential accessories that you'll want and need are included right in the basic models. For instance, the dual-purpose rig shown in operation on the Penn-Can Highway is ready to operate anywhere! It's completely self-contained with its own power plant, built-in pump, cargo-type hoisting winch, full 360° operating hydraulic feed head and dozens of other useful features. This particular derrick equipped rig was designed to operate from the trailer, or slid-off and used on its skid base.

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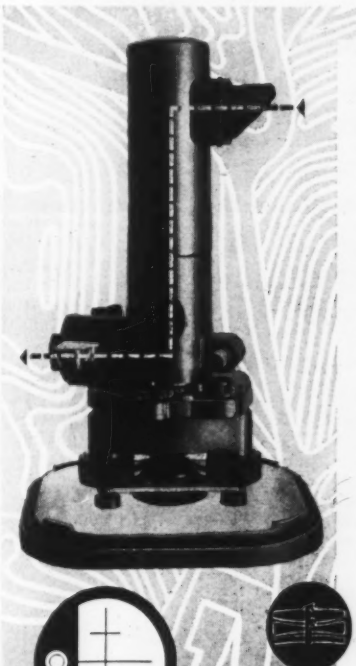
Over 40 years of experience manufacturing a complete line of diamond and shot core drills, accessories and equipment



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Automation Cuts Costs

Once a bull's eye bubble is just roughly centered, the suspended leveling unit keeps automatically the line of sight within 2 seconds from the true horizontal. The instrument can be set up 3 times faster than an ordinary level, and has no sensitive vial requiring adjustments for temperature.

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(continued)

Power Roof Ventilator Designs

To BETTER CONFORM WITH climatic conditions and architectural requirements, new power roof ventilator designs have been announced. The silhouette of the new models is lower than that of the old.

The new motor covers are separated from the fan hoods with an optimum air space which permits better motor ventilation, while retaining a weather-proof design. This air space results in negligible chamber resonance, and causes any mechanical sound pattern to be nullified by the air flow. The motor is, of course, out of the air stream. Another feature is the Vibratrol, which is a special method of cushioning the motor frame, and is employed on all models. All motors have lifetime sealed bearings. **Carnes Corp., CE-11, Verona, Wisc.**

Low-priced Whiteprinter

A RAPID PRINTING, COMPACT, low-priced, semi-automatic whiteprinting machine, the Scout will print and develop at speeds up to 20 ft per minute, and will accommodate prints up to 45 in. in width and of practically any length.

The machine will quickly reproduce in cut sheets or rolls anything typed, written, drawn or photographed on reasonably translucent material. Finished prints are delivered in original sequence, completely dry and ready for immediate use.

This unit is equipped with a 2000-watt printing lamp, removable from either side, a ribbed rubber sealing sleeve which conveys prints through the developer over a perforated Teflon slip-screen, an extremely smooth surface for all types of materials. **C. F. Pease Co., CE-11, 3944 North Rockwell St., Chicago 18, Ill.**

Third Mars Design Contest

BECAUSE THE MARS OUTSTANDING Design Contests have uncovered numerous interesting designs which might otherwise never have been brought before technical audiences, Mars Pencils is sponsoring another contest in 1959.

The winning designers will again be paid $100 and will have their designs reproduced in the wide list of technical publications in which the Mars Outstanding Design Series appears. There are no strings attached; the designer is given full credit and retains all future rights to his project.

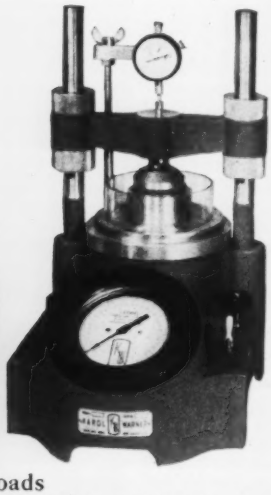
The subject can be in the field of aviation, space travel, autos, trains, buildings, engineering structures, household items, tools, machines, business equipment—almost anything. **J. S. Staedtler, Inc., CE-11, Hackensack, New Jersey.**

Self-Propelled Excavator

FAST, RUBBER-TIRE MOBILITY and one-man operation have always been desirable characteristics of self-propelled excavators, but the bad terrain encountered on most construction jobs frequently has limited their use.

Now, a new spring-mounted oscillating front axle is standard on the ¾-yd Model SP-107, allowing the front wheels to hug the ground so the 4-wheel drive can apply the tractive effort necessary to carry this rubber-tire excavator over the rough, soft ground of off-the-highway construction sites. There are always enough wheels in contact with the ground to kick the machine over the rough or soft spots; hang-up and wheel-spin are no problems. **The Thew Shovel Co., CE-11, Lorain, Ohio.**

Unmatched for Efficient Consolidation Soil Testing...



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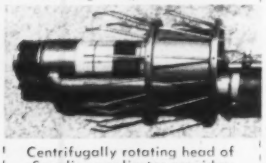
Cement mortar lining is applied uniformly by centrifugal "Spunline" Process.



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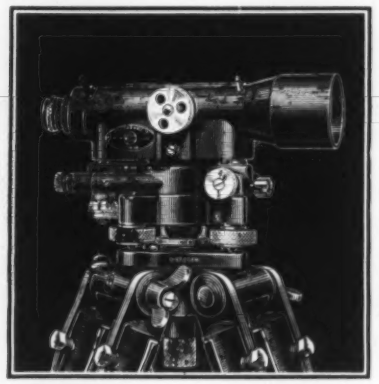

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Watts Microptic Engineers' Levels are tops with foremost construction engineers throughout the country. Here is precision performance, time-saving performance, dependable performance in all climates and terrain. For full information on the complete line of Watts Microptic Engineers' Levels see your nearby Dietzgen Dealer. Made by Hilger & Watts, Ltd., London, sold and serviced in the United States by the Eugene Dietzgen Co.

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EQUIPMENT MATERIALS and METHODS

(continued)

Lightweight Dump Body

CALLED THE TWIN YARD BIRD, this lightweight dump body made specially for one-ton truck chassis is constructed of 12 gauge steel.

Drivers are able to maneuver this compact unit easily, load quickly, and dump material exactly where it is needed. Powerful 8-ton lift capacity is provided by a twin head lift high pressure hoist, providing double stability, strength, and lift power. The hoist has a full subframe to take stresses, and thus puts no strain on the truck frame. It is driven by power takeoff from the truck transmission.

Since lift power is applied ahead of load center, maximum lift advantage is achieved. The forward position of the hoist allows greater stability with less hoist weight. As a result, the truck can carry more payload on every trip.

All are equipped with straight hung,

8-Ton Lift Capacity

double acting tail gates, with full duty hardware. Crossmembers and structural longitudinals in the frame give full support to the entire floor area. Gussets are provided for additional planking or steel side boards. **Anthony Company, CE-11, Streator, Ill.**

Large Brick Chimney

APPEARING AS PART OF the sky line of Pittsburgh, Pa., at the new sewage treatment plant of the Allegheny County Sanitary Authority, is a 300-ft blue glazed brick chimney. It is the first one of this size to be built of a solid color in the United States. Having already reached a height 130 ft, it is being raised skyward at a rate of 4 ft per day.

The 34-in. thick chimney walls are made up of 5 rings of brick. The special blue face bricks are laid in a blue-tinted mortar with back-up materials consisting of buff brick made of refractory clay and regular cement mortar. The outside diameter of the 300-ft chimney is 33 ft 8 in. at the bottom tapering to 18 ft at the top. **The Rust Engineering Co., CE-11, 930 Fort Duquesne Blvd., Pittsburgh 22, Pa.**

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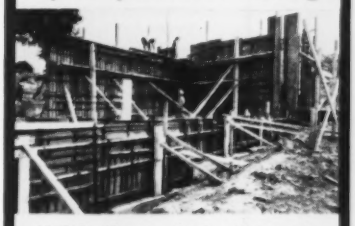
speed-up concrete forming



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so simple to use:
1 PEEL the tri-acetate adhesive from its backing.
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Literature Available

TECHNICAL SURVEYS—A four-page brochure on technical surveys and their importance in any sound product development program has been published. Defining the technical survey as the organized process of obtaining pertinent product data on user requirements, applications, competitive products and market conditions, it discusses six actual types of these surveys: technical-economic studies, analysis of production data, feasibility studies, product diversification surveys, new use-requirements, and merger studies. **Designers for Industry, CE-11, 4241 Fulton Parkway, Cleveland 9, Ohio.**

GRAPH-A-PLAN—Five new catalogs on the Graph-A-Plan system, which also serve as instruction manuals for making a wide selection of charts and layouts have been released. Entitled Statistical Charting, Office Layouts, Plant Layouts, Organization Charts, and Process & Flow Charts, each manual includes a brief description of the system, detailed instructions for layout and charting, and a list of materials available. **Labelon Tape Co., Inc., CE-11, 450 Atlantic Ave., Rochester 9, N. Y.**

FIBERGLAS INSULATIONS—In 12 pages and by photos, tables, sketches, and a graph, the publication, "Fiberglas Insulations for Industrial & Commercial Metal Buildings," illustrates and describes the use of Fiberglas flexible and rigid metal building insulations. Discussed are factors such as heat losses and condensation and accessory materials for metal buildings, such as reinforced plastic paneling, ceiling board, accoustical tile, and perimeter and pipe and duct insulation. **Owens-Corning Fiberglas Corp., CE-11, Toledo 1, Ohio.**

ROTARY AIRLOCK FEEDERS—A new 12-page technical manual P-58, explains how to select a rotary airlock feeder: what it is; what it does; and where it is used. Also included are detailed descriptions of 27 different airlocks for standard duty, heavy duty, a blow-thru applications, as well as specifications and dimensional drawings which can be used by engineers for layout purposes. **Prater Pulverizer Co., CE-11, 1515 South 55th Court, Chicago 50, Ill.**

CYLINDER-FINISH TUBING—A four-page, two-color bulletin describing a new line of improved "Rockrite" tubing for use in hydraulic equipment has been released. Some of the production short-cuts possible with the tubing are described as elimination of boring and honing, a rework of interior parts, and damage to packing. The brochure also contains tables of tolerances, eccentricity, straightness and mechanical properties for the assistance of designers, engineering staffs and purchasing agents. **Tube Reducing Corp., CE-11, P. O. Box 959, Wallington, N. J.**

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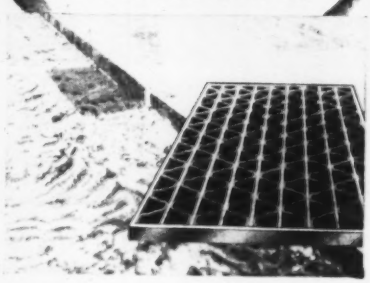

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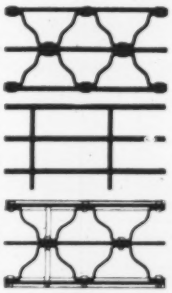

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From the MANUFACTURERS

NEW DIVISION: The formation of the Nuclear Safety Div. of Bryne Associates, Inc. of 50 Broadway, New York City and 81 So. Bergen Place, Freeport, N. Y., has been announced. It will be under the direction of Dr. James B. Kelley, formerly consultant to the State of New York on atomic energy . . . **LIBRARY ESTABLISHED:** Catalogs and literature will be welcome at the technical library of The Ralph M. Parsons Co., Dacca, East Pakistan. The company has been retained by the ICA to design, supervise, and furnish the necessary technical assistance for a water system project which includes treating, storage and distribution facilities, and waste water collection, treatment and disposal for the cities of Dacca and Chittagong, East Pakistan . . . **RETIREMENT ANNOUNCED:** The Board of Directors of the Lehigh Portland Cement Co. has acceded to the request of Mr. C. Glenn Browning, Executive Vice President, Sales, for early retirement after 37 years of service, to become effectiv December 31, 1958. He will continue to serve as a Director of the company . . . **DISTRIBUTORS APPOINTED:** A supplier of metal to appliance and office equipment industries in the east and midwest, Hynes Steel Products Co. has been appointed a general line industrial distributor for Reynolds Metals Co. . . . Owens-Corning Fiberglas Corp. has become a distributor of Fiberglas Permadrain gutter and downspout systems, manufactured by Permanent Products, Inc., St. Paul, Minn. . . . **PLANT MODERNIZATION:** General Electric Co. plans to spend $47 million during the next five years to modernize its plants in Pittsfield, Mass. . . . **COMPANY FORMED:** The John Ulrich Co. has been formed to produce auxiliary equipment for Caterpillar machines, according to an announcement by John J. Ulrich, President of the new firm . . . **AWARDED CONTRACT:** Atlas Copco has been awarded a contract to supply all the air compressors, rock drills and other pneumatic equipment which will be used in driving the Italian side of a major highway tunnel linking Italy and France through the 15,771-ft high Mont Blanc in the Alps . . . **NEW REPRESENTATIVES:** Strengthening of its sales and service team by appointment of new representatives in the key market areas of Chicago, Eastern Canada, Iowa, Nebraska, the Quad-cities, and Denver was disclosed by Sam Horwitz, President of Midcontinent Tube Service, Inc., and Midco Valves & Fittings, Inc., Evanston, Ill. . . . **APPOINTMENTS:** C. E. Lamar has been named Assistant Sales Manager for Southern Pipe & Casing Co., Azusa, Calif., a division of U. S. Industries, Inc. Southern Pipe manufactures welded steel pipe for water, gas and oil transmission . . . George A. Hagerty has been promoted to manager of the marketing section of the General Electric Computer Department.

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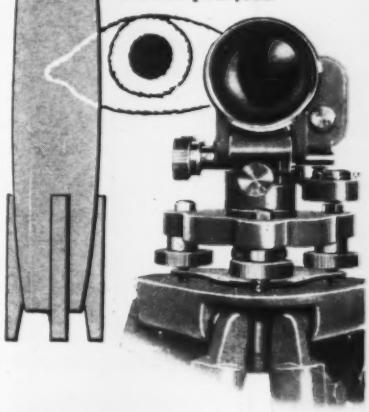

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Journals: Structural, Hydraulics, Soil Mechanics and Foundations, Engineering Mechanics, Highway, Power.

1790. Minimum Weight of Frames Under Shakedown Loading, by Jacques Heyman. (EM) This paper examines the minimum weight design of framed structures under both fixed and independently varying loads. A numerical example is given, for which the solution is obtained, and the results corresponding to the two types of loading are compared.

1791. Effect of End-Fixity on the Vibration of Rods, by D. Burgreen. (EM) A study is made of the free vibration of rods with end supports of equal elasticity. Expressions are derived relating the end-fixity to frequency and mode of vibration. With the proper type of negative springs attached to the ends of the rod, it is shown that vibrations can be surpressed.

1792. Eccentrically-Loaded, Hinged Steel Columns, by R. E. Mason, G. P. Fisher and Geo. Winter. (EM) Tests are reported on thirty eccentrically and concentrically loaded steel columns. Failure loads are compared with predictions by the secant formula and other current methods.

1793. Approximate Buckling Loads of Open Columns, by Yu-kweng M. Lin. (EM) A general equation applicable to any boundary conditions for coupled buckling of thin-walled open columns is presented. It is found that a most general problem of triple coupling may be solved approximately as two double coupling cases.

1794. Dynamic Effect of a Moving Load on a Rigid Frame, by R. C. De Hart. (EM) The dynamic effect of a distributed load moving with constant velocity across a rigid frame is described in this paper. It is demonstrated that a single impact factor is not applicable to all parts of the frame.

1795. The Research Phase of the AASHO Road Test, by W. N. Carey, Jr. (HW) In this report the principles underlying the experiment design for the AASHO Road Test are examined along with the basic analyses that will be performed. The principal dependent variable is defined and the independent design variables are listed.

1796. The History of Road Tests, by E. A. Finney. (HW) This report traces the construction of different types of road tests in the United States from the latter part of the 18th century to the AASHO Road Test now under construction in the State of Illinois.

1797. Creating a Better Understanding of Traffic Engineering, by Donald M. McNeil. (HW) The increasing use of private motor vehicles has necessitated the specialization known as Traffic Engineering. This phase of engineering deals with the planning of streets, highways, abutting lands, and with traffic operation thereon.

1798. The AASHO Road Test, by W. B. McKendrick, Jr. (HW) The AASHO Road Test at Ottawa, Illinois is sponsored by the American Association of State Highway Officials. This paper outlines objectives and purposes, administrative procedures, financing, and progress of the construction of the test facility.

1799. Reinforcement in Continuous Concrete Pavements, by Vedat A. Yerlici. (HW) An analytical approach to a national design method is presented for the reinforcing steel in continuous concrete highway pavements. Formulas are derived, giving needed steel area and perimeter to insure against widening of cracks in the slab.

1800. Tests of Concrete Pavements on Gravel Subbases, by L. D. Childs and J. W. Kapernick. (HW) This paper examines the effect of subbase thickness on pavement performance, concluding that a greater load capacity can be achieved by thickening the concrete rather than by building deep subbases.

1801. Urban Transportation Problem: Progress Report of the Committee on Urban Transportation of the Highway Division. (HW) Cities must achieve a rational balance between essential modes of transportation, and the modern urban complex demands an areawide approach to the problem. Transportation planning must be more closely integrated with economic, sociological and political factors.

1802. Needs Studies on a Continuing Basis, by R. E. Livingston. (HW) This paper outlines the necessity for a standard procedure for preparing cost estimates used in needs studies of highway systems. It considers elements of the estimate and the work items comprising them.

1803. Comprehensive Transportation Planning, by R. I. Creighton. (HW) Systematic methods are described for analyzing data and preparing and testing plans for all types of transportation facilities in urban areas, based on forecasts of traffic as generated by future land uses.

1804. Need of the Interstate System of Highways, by G. M. Williams. (HW) Provisions of the Federal-Aid Highway Acts from 1916 through 1956, the actions leading to establishment of the Interstate System of Highways in 1944, and the plans for accelerating the rate of construction are reviewed.

1805. The Federal Highway Program in New York State, by John W. Johnson. (HW) This paper examines the efforts of the federal and state governments in the building of the nation's highways from 1916 to the present day. A synopsis is developed of New York State's multi-billion dollar construction program with illustrative comments on area alignments.

1806. Sedimentation Studies in the Western Gulf States, by Graham W. Renfro and Charlie M. Moore. (HY) A summary of the more important reservoir sedimentation surveys made by the Soil Conservation Service in the area is presented. Methods used in determining sediment yields are described. The effect of watershed protection measures, including floodwater retarding structures in reducing sediment yield from watershed is examined.

1807. Some Experiments with Emergency Siphon Spillways, by Warren B. McBirney. (HY) Two model designs of low head siphon spillways were tested. Operational characteristics and peculiarities of the two siphon designs are discussed and supporting data and pictures are included.

1808. Synthetic Flood Frequency, by Franklin F. Snyder. (HY) A procedure is developed for computing the flood discharge probability associated with a given rainfall-duration-frequency pattern on natural drainage basins, nonchannelized overland flow areas and areas with storm sewer drainage.

1809. Divining Rods Versus Hydrologic Data and Research, by W. B. Langbein. (HY) The divining rod as a mystical hydrologic decision-maker is contrasted with modern basic-data programs. The extent and kinds of gaps in basic data are discussed with emphasis on deficiencies in research and interpretation.

1810. Numerical Solution of Flow Problems in Rivers, by E. Isaacson, J. J. Stoker and A. Troesch. (HY) New methods for dealing with flow problems in large rivers and reservoirs for lengthy periods of time are developed. The simplicity and flexibility of the methods are explained.

1811. Queuing Theory and Water Storage, by W. B. Langbein. (HY) A method for determining the amount of holdover storage for regulating streamflow is presented based on analogies with queues. Where discharge varies linearly with reservoir contents a unique expression is derived. The queuing analogy leads to a general solution by "probability routing."

1812. Analysis for Partially Penetrating Sand Drains, by E. G. Hart, R. L. Kondner, and W. C. Boyer. (SM) A numerical procedure of

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analysis for partially penetrating sand drains has been developed. Possible simplified methods of analysis are indicated and laboratory tests have been conducted to correlate these methods with observed rates of consolidation.

1813. Grouting Deep Solution Channels Under an Earth Fill Dam, by Leland F. Grant and Lewis A. Schmidt. (SM) Deep limestone solution channels caused leakage under an elliptical earth fill dam which forms a pond for log storage at Bowaters Southern Paper Corporation's newsprint mill at Calhoun, Tennessee. The foundation was stabilized by grouting and leakage was eliminated successfully.

1814. Digital Computation for Stiffness Matrix Analysis, by J. S. Archer. (ST) A matrix method is described for the static stress and normal mode analysis of highly indeterminate structures on large scale digital computers. This method is applied to the analysis of basic types of civil engineering structures.

1815. Numerical Solutions for Interconnected Bridge Girders, by Henry Malter. (ST) Two numerical methods for the solution of the problem of interconnected bridge girders are considered for the particular case involving infinite torsional rigidity of the main longitudinal members for two-girder and four-girder structures.

1816. Generalization of the Successive Approximations Method, by Panagiotis D. Moliotis. (ST) This paper presents the theory and the methods of analysis of rigid frames whose joints are not points but are considered as small undeformed areas. These frames are analyzed by the method of successive approximations and examples are presented.

1817. Golden Gate Bridge Vibration Studies, by George S. Vincent. (ST) Presented are the results of observations of the movements of the Golden Gate Bridge. Correlations with theoretical calculations of wave forms and wind tunnel tests indications of the behavior to be expected of the bridge are made.

1818. Concrete Beams and Columns With Bundled Reinforcement, by N. W. Hanson and Hans Reiffenstuhl. (ST) Tests of pairs of large beams with conventionally spaced and with bundled longitudinal reinforcement are reported. No significant difference in behavior or strength was found for bundled as compared to spaced reinforcement.

1819. Matric Formulation of Slope-Deflection Equations, by Chu-Kia Wang. (ST) A simple and systematic way is outlined so that slope-deflection equations may be put in matric form. This method will expedite the exact analysis of many complex rigid frames under many loading conditions, including sideways.

1820. Deflection of Variable Stiffness Members, by D. G. Fertis and E. C. Zobel. (ST) This paper determines deflection of members with variable stiffness by selecting a reference value and by replacing a member with an equivalent system having a uniform stiffness.

1821. Amplification of Stress and Displacement in Guyed Towers, by Robert S. Rowe. (ST) Problems dealing with the amplification of stress and displacement in guyed towers when changes in geometry are included in the analysis are presented. A simplified method for determining the slack stress in the guy and horizontal displacements due to wind load are also considered.

1822. Large Deflection of Elasto-Plastic Plates Under Uniform Pressure, by Thein Wah. (EM) The differential equation for the deflection of an infinitely long plate is well known. In this paper the analysis is carried into the plastic range for the case of uniform and clamped edges.

1823. The Pelton Hydro-Electric Development, by J. M. Mullarkey. (PO) A description of the project, of the design of the dam and spillway, and of the construction plant and progress is given in this paper.

1824. Computation of the Stability of Slopes, by Otto H. Meyer. (SM) This paper develops analytical formulas for the solution of problems involving the stability of earth slopes and embankments, and included graphs making it possible to solve these problems with a minimum of computations.

1825. Consolidated C.B.R. Criteria, by R. G. Ahlvin. (SM) Flexible pavement design criteria as used by the Corps of Engineers are reduced to a single plot and compared with all available service-behavior-type data. The data, which include test section and documented in-service results, are tabulated.

1826. Progress Report on Glossary of Terms and Definitions in Soil Mechanics. (SM) This report, prepared by the ASCE Committee on Glossary of Terms and Definitions in Soil Mechanics presents a compilation of terms, definitions and symbols currently in use in soil mechanics literature.

1827. Discussion of Proceedings Paper 1436, 1437, 1509, 1560, 1562, 1633. (ST) Per Hall, Troels Bromdun-Nielsen and H. R. Kivisild closure to 1436. Alan M. C. Holmes closure to 1437. Juergen Plaehn on 1509. Corrections to 1509. I. M. Nelidov on 1560. Victor R. Bergman and N. J. Ryker, Jr. on 1562. A. Kabaila on 1633.

1828. Discussion of Proceedings Paper 1309, 1427, 1428, 1429, 1535, 1537, 1545, 1546, 1547, 1548, 1549, 1550 1552, 1654, 1655. (SM) R. W. Johnson closure to 1309. H. B. Seed and C. K. Chan closure to 1427. K. S. Bawa closure to 1428. Gunnar M. Brune closure to 1429. Lymon C. Reese and Hudson Matlock, John A. Focht on 1535. D. C. Pearce corrections to discussion 1657. Bruce E. Clark on 1545. Bruce E. Clark on 1546. Bruce E. Clark on 1547. Bruce E. Clark and L. A. Schmidt, Jr. on 1548. Bruce E. Clark on 1549. Bruce E. Clark on 1550. L. A. Schmidt, Jr. on 1552. B. P. Warkentin and R. N. Y. Yong and G. A. Leonards on 1654. Alfred C. Scheer, R. N. Y. Yong and P. B. Warkentin on 1655.

1829. Discussion of Proceedings Paper 1372, 1374, 1626, 1627. (HW) Alfred C. Scheer closure to 1372. Joseph Barnett closure to 1374. Wilson Davis and Lewis H. Tuthill on 1626. Stephen G. Petersen on 1627.

1830. Discussion of Proceedings Paper 1330, 1398, 1414, 1420, 1488, 1598. (PO) J. Barry Cooke and Arthur G. Strassburger closure to 1330. E. L. Seeland closure to 1398. Howard A. Preston, and Louis E. Rydell closure to 1414. Sylvan J. Skinner closure to 1420. R. T. Richards closure to 1488. F. C. Rodriguez, Stavros N. Nicolaou on 1598.

1831. Discussion of Proceedings Paper 1390, 1399, 1496, 1596, 1604, 1706. (EM) H. M. Nelson, D. T. Wright and J. W. Dolphin closure to 1390. Seng-Lip Lee closure to 1399. Corrections to 1496. Corrections to 1596. Keith Jones on 1604. Corrections to 1706.

1832. Discussions of Proceedings Papers 1197, 1201, 1260, 1264, 1266, 1331, 1345, 1393, 1395, 1401, 1402, 1403, 1405, 1401-1406, 1401 and 1405, 1406. (HY) John L. Bogardi on 1197. Closure to 1197. W. G. Whippen and G. D. Johnson closure to 1201. Ahmed Shukry closure to 1260. R. H. Berryhill closure to 1264. M. B. McPherson and M. H. Karr closure to 1266. Walter C. Carey and M. Dean Keller closure to 1331. P. K. Kandaswamy and Hunter Rouse closure to 1345. F. Paderi on 1345. J. M. Robertson and G. L. Calehuff closure to 1393. E. Kuiper closure to 1395. J. N. Bradley and A. J. Peterka closure to 1401. J. N. Bradley and A. J. Peterka closure to 1402. J. N. Bradley and A. J. Peterka closure to 1403 J. N. Bradley and A. J. Peterka closure to 1406. J. N. Bradley and A. J. Peterka closure to 1401-1406. Corrections to discussion to 1616. J. N. Bradley and A. J. Peterka closure to 1401 and 1405.

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